



LIFE SCIENCES STRATEGIES

# **The Northern Ontario Biotechnology Initiative**

## **Submission to the Biotechnology Cluster Innovation Program**

July 21, 2004

## Letter from SHI Consulting

The submission of this document marks the end of a significant journey that the Steering Committee of the Northern Ontario Biotechnology Initiative (NOBI) has undertaken with Sharon Cuddy, the NOBI Project Manager, and SHI Consulting. As the strategic management consultancy retained by the NOBI, SHI Consulting has welcomed the opportunity to work with this team in facilitating the creation of a strategic plan and devising a Regional Innovation Network called NOBI to create better connectivity for biotechnology stakeholders across Northern Ontario.

The willingness of the stakeholders to look beyond their individual regional interests, and their flexibility to create something new and innovative, has created an asset for not only for Northern Ontario, but also for the Province of Ontario. Herein we describe the new NOBI organization. This new organization will establish a central point-of-entry vehicle to facilitate industry access to Northern Ontario's biotechnology industry and will allow exploration of biotechnology applications in the traditional industries of forestry and mining. We are tremendously optimistic that NOBI will allow biotechnology to continue to grow as an industry of importance for Northern Ontario.

I would like to extend our sincere appreciation to all of those involved in this process. Sharon Cuddy's organization and experience has been very helpful in this process. The members of the Steering Committee deserve special thanks for their efforts in helping with the final crunch in the development of this plan. We offer our appreciation to these individuals and their organizations, institutions and companies for the immense time that they dedicated to this process. NOBI was gifted with the active participation of many from the government support team, including David DeYoe, Bob Jeffery, Jason Koivisto, Paul Podstawka, Anna Ilnyckyj and Indira Singh. Last, but certainly not least, I would like to thank the MEDT representatives, Brad Defoe, Bill Mantel and George Cadete, whose passion and enthusiasm for growing biotechnology in Northern Ontario was always foremost.

In closing, it was an honour to participate in the development of such a dynamic and innovative undertaking. On behalf of SHI Consulting, I would like to send my best wishes to NOBI as they undertake what is sure to be an exciting and challenging process.

Sincerely,



Borys Chabursky  
President  
SHI Consulting Inc.

<b>LETTER FROM SHI CONSULTING .....</b>	<b>2</b>
<b>1 – THE REGIONAL INNOVATION PROFILE .....</b>	<b>6</b>
1.1 EXECUTIVE SUMMARY .....	7
1.2 COMMUNITY AND AREA PROFILE.....	8
1.2.1 <i>The Pan-Northern Region: Total Area, Population, and Demographics</i> .....	8
1.2.2 <i>Physical Infrastructure Inventory</i> .....	10
1.2.3 <i>“Soft” Commercialization Infrastructure</i> .....	12
1.2.4 <i>Business and Economic Development</i> .....	16
<b>1.3 INDUSTRY PROFILE .....</b>	<b>19</b>
1.3.1 <i>Total Employment, Unemployment, and Employment by Industry Sector</i> .....	19
1.3.2 <i>Major Sector: The Mining Industry</i> .....	22
1.3.3 <i>Major Sector: The Forestry Industry</i> .....	27
1.3.4 <i>Key Regional Growth Factors</i> .....	30
<b>1.4 EDUCATION AND SKILLS PROFILE.....</b>	<b>31</b>
1.4.1 <i>Universities</i> .....	31
1.4.2 <i>Colleges</i> .....	33
<b>1.5 SKILLS AND EDUCATION PROFILE OF THE NOBI REGION.....</b>	<b>36</b>
<b>1.6 RESEARCH &amp; DEVELOPMENT PROFILE .....</b>	<b>38</b>
1.6.1 <i>University Research Initiatives</i> .....	38
1.6.2 <i>Health Research Initiatives</i> .....	42
1.6.3 <i>Forestry/Agriculture/Environment Research Initiatives</i> .....	47
1.6.4 <i>Mining Research Initiatives</i> .....	52
1.6.5 <i>Other Research Initiatives</i> .....	53
1.6.6 <i>Technology Transfer Infrastructure</i> .....	54
1.7 TRANSPORTATION AND TECHNOLOGY INFRASTRUCTURE .....	55
1.8 NATURAL RESOURCES AND SPECIALTY INFRASTRUCTURE .....	57
1.9 REGIONAL SWOT ANALYSIS AND CONCLUSIONS.....	59
1.9.1 <i>Strengths</i> .....	61
1.9.2 <i>Weaknesses</i> .....	63
1.9.3 <i>Opportunities</i> .....	64
1.9.4 <i>Threats</i> .....	66
<b>2 - THE BIOTECHNOLOGY PROFILE.....</b>	<b>67</b>
2.1 EXECUTIVE SUMMARY .....	68
2.2 INTRODUCTION.....	70
2.2.1 <i>Objectives</i> .....	70
2.2.2 <i>Geographic Boundaries of the NOBI Region</i> .....	71
2.2.3 <i>Integration of the Cluster within Wider Geographic Scope</i> .....	71
2.2.4 <i>Description of the NOBI and its Members</i> .....	71
2.3 NORTHERN ONTARIO BIOTECHNOLOGY CLUSTER VISION AND MISSION .....	72
2.3.1 <i>Vision Statement</i> .....	72
2.3.2 <i>Mission Statement</i> .....	72
2.3.3 <i>Goals &amp; Objectives</i> .....	72
2.4 DESCRIPTION OF CLUSTER’S BIOTECHNOLOGY AND RELATED ASSETS .....	73
2.4.1 <i>Industry Profile</i> .....	73
2.4.2 <i>Industry Receptor Capacity</i> .....	76
2.4.3 <i>Education and Skills Profile for Biotechnology and Related Convergent Industries</i> .....	84
2.4.4 <i>Research Excellence</i> .....	88
2.4.5 <i>Technology Transfer, Commercialization and Venture Capital</i> .....	90

2.4.6	<i>Additional Supporting Infrastructure</i> .....	91
2.5	BIOTECHNOLOGY AND RELATED INDUSTRIES SWOT ANALYSIS .....	92
2.6	IDENTIFICATION AND ANALYSIS OF NICHE BIOTECHNOLOGY AREAS .....	95
2.6.1	<i>Identification of Industry Strengths and Gaps</i> .....	95
2.6.2	<i>Identification of Cluster Supply Factors</i> .....	97
2.7	KEY STRATEGIC DIRECTIONS, PROJECTS AND INITIATIVES .....	103
2.7.1	<i>Strategic Initiative #1: Building Northern Ontario’s Biotechnology Engine</i> .....	105
2.7.2	<i>Strategic Initiative #2: Major Provincial Role in the Public Health Subcluster</i> .....	107
2.7.3	<i>Strategic Initiative #3: Major Provincial Role in the Bioproducts Subcluster</i> .....	109
2.7.4	<i>Strategic Initiative #4: Major Provincial Role in the Environment Subcluster</i> .....	110
2.8	CLUSTER PERFORMANCE MEASURES .....	112
2.9	NEXT STEPS .....	114
<b>3</b>	<b>- THE BUSINESS PLAN.....</b>	<b>115</b>
3.1	EXECUTIVE SUMMARY .....	116
3.2	BACKGROUND & RATIONALE .....	118
3.3	OVERVIEW OF NORTHERN ONTARIO’S SECTOR-SPECIFIC STRENGTHS.....	119
3.3.1	<i>Forestry Bioproducts</i> .....	119
3.3.2	<i>Mining and Environmental Technologies</i> .....	119
3.3.3	<i>Biomedical</i> .....	119
3.4	OPERATIONAL MODEL .....	121
3.5	REGIONAL NEEDS .....	122
3.5.1	<i>Industry Needs</i> .....	122
3.5.2	<i>Research Needs</i> .....	122
3.5.3	<i>Other Needs</i> .....	123
3.6	MANDATE .....	124
3.7	PROGRAMS & SERVICES.....	124
3.7.1	<i>Outreach</i> .....	124
3.7.2	<i>Commercialization Support</i> .....	125
3.8	OPERATIONAL AND ORGANIZATIONAL STRUCTURE.....	126
3.8.1	<i>Operational Overview</i> .....	126
3.8.2	<i>Organizational Model</i> .....	130
3.8.3	<i>Governance Model</i> .....	133
3.9	SUCCESS METRICS .....	133
3.9.1	<i>Impacts</i> .....	134
3.9.2	<i>Timelines</i> .....	135
3.9.3	<i>Synergies and Partnerships</i> .....	135
3.10	FINANCIAL HIGHLIGHTS.....	137
3.10.1	<i>Summary of Expenses</i> .....	137
3.10.2	<i>Summary of Revenues Sources</i> .....	137
3.10.3	<i>Investment Request</i> .....	137
3.10.4	<i>Sustainability</i> .....	138
3.11	INTRODUCTION TO BUSINESS CONCEPTS.....	138
3.11.1	<i>The Genomics-North Initiative</i> .....	138
3.11.2	<i>Bioenergy</i> .....	149
3.11.3	<i>Bioprospecting: Natural Products and Drug Discovery</i> .....	160
3.11.4	<i>Telehealth &amp; Medical Robotics</i> .....	169
3.11.5	<i>Biomining and Bioremediation</i> .....	176
3.11.6	<i>Not-For-Profit Phase 1 Clinical Research Organization</i> .....	181
3.12	CONCLUSIONS AND NEXT STEPS .....	186
	<b>APPENDIX 1 EXISTING ECONOMIC DEVELOPMENT PLANS .....</b>	<b>187</b>
	<b>APPENDIX 2 TOP EMPLOYERS IN THE PAN-NORTHERN REGION.....</b>	<b>192</b>
	<b>APPENDIX 3 THE UNIVERSITIES LOCATED IN NORTHERN ONTARIO.....</b>	<b>199</b>
	<b>APPENDIX 4 THE COLLEGES OF NORTHERN ONTARIO.....</b>	<b>207</b>

**APPENDIX 5 HARVEST RATES AND SUSTAINABILITY OF FORESTRY RESOURCES IN NORTHWESTERN ONTARIO ..... 210**

**APPENDIX 6: THE NOBI STEERING COMMITTEE ..... 213**

**APPENDIX 7: DETAILED FINANCIAL PLAN ..... 216**

**APPENDIX 8A: NORTH BAY/NIPISSING/MUSKOKA REGIONAL INNOVATION PROFILE 217**

**APPENDIX 8B: SAULT STE. MARIE/ALGOMA REGIONAL INNOVATION PROFILE ..... 218**

**APPENDIX 8C: SUDBURY/MANITOULIN/PARRY SOUND REGIONAL INNOVATION PROFILE ..... 219**

**APPENDIX 8D: THUNDER BAY/NORTHWESTERN ONTARIO REGIONAL INNOVATION PROFILE ..... 220**

**APPENDIX 8E: TIMMINS/COCHRANE/TEMISKAMING REGIONAL INNOVATION PROFILE ..... 221**

# **1 – The Regional Innovation Profile**

## 1.1 Executive Summary

The Northern Ontario Biotechnology Initiative (NOBI) is composed of representatives from Northeastern and Northwestern Ontario. There are vast distances separating the members of this initiative; however despite this geographic diversity the region as a whole exhibits significant strengths in two industry sectors with the capacity to both develop and utilize technology and innovation. The two dominant industry sectors that characterize Northern Ontario as significantly different from its southern neighbors are mining and forestry.

Northern Ontario has a vast quantity and variety of mineral assets, and much of these resources are refined at local facilities. The Sudbury basin in particular is Canada's major mining centre, with deposits of nickel, copper, cobalt, platinum, palladium and gold. Local companies, such as Inco and Falconbridge, invest locally in research and development. Timmins is also a leading mining area with over 50 mines that have been opened. The mining presence throughout Northern Ontario has also catalyzed the growth of a significant mining supply and services sector.

The biomass resources found in Northern Ontario are unprecedented in Ontario, Canada and likely the world. Canada has been characterized as the "Saudi Arabia of Biomass" and this asset has emerging growth potential in the new bio-based economy. Interest in the use of bio-based products versus fossil fuel-based products is emerging due to governmental initiatives (such as the Kyoto Accord), and the decreasing and unstable supply of oil. Companies active in the biomass economy, such as Tembec, are active in Northern Ontario. As well, the region has significant capabilities in the processing of biomass and the manufacturing of wood and paper products.

Despite strengths in these two industry sectors, the NOBI area has been affected by higher than Ontario average unemployment rates and significant youth out-migration. However, the continued shift to a knowledge based economy with a greater adoption and commercialization of biotechnology is an important opportunity for Northern Ontario. To assist in this growth, significant funding opportunities are available for companies located in Northern Ontario, such as FedNor and the Northern Ontario Heritage Fund Corporation. These, and other funding sources, are a key asset for attracting, growing and retaining industry within the local area. Additional opportunities for Northern Ontario exist in the new Northern Ontario Medical School and in the increasing participation of local universities in technology transfer and commercialization activities.

## 1.2 Community and Area Profile

The Northern Ontario Biotechnology Initiative (hereinafter referred to as 'NOBI') consists of five regions of northern Ontario: North Bay/Nipissing/Muskoka, Sudbury/Manitoulin/Parry Sound, Sault Ste. Marie/Algoma, Timmins/Cochrane/Temiskaming and Thunder Bay/Northwestern Ontario. Each of the five regions has produced a regional innovation profile aligned with the requirements of the Ministry Economic Development and Trade (MEDT) attached hereto as Appendix 8. Please refer to Appendix 8 for detailed information pertaining to specific communities. This report represents the combined profiles of each region and is therefore a pan-northern innovational innovation profile. Each region brings unique strengths to NOBI and it is anticipated that there will be significant collaboration and integration among the communities. It is also anticipated that there will be significant interactivity between NOBI and other developing biotechnology clusters throughout Ontario, Canada and internationally.

### 1.2.1 The Pan-Northern Region: Total Area, Population, and Demographics

#### Land Area

The geographic area encompassed by the NOBI study area is a vast expanse of approximately 822,000 square kilometres which accounts for nearly 90% of Ontario's total land area. This region is home to approximately 7% of Ontario's population. The majority of Northern Ontario's population and urban centres are located throughout the southern band of the region and are linked by transportation infrastructure (rail, road, and shipping). The pan-Northern region borders Manitoba to the west and Quebec and other regions of Ontario to the east. To the south, the NOBI regions border the USA, Lake Superior, Lake Michigan and other regions of Ontario, which include Simcoe and Haliburton counties.



**Figure 1: Map outlining the 5 NOBI regions.** The encircled area indicates the region encompassed by the NOBI proposal. Note: the circle approximates the borders of NOBI and is not meant to represent a detailed geographical border.



**Population**

As of 2001, the pan-Northern population was estimated to be 831,327<sup>1</sup>. This area has experienced a decrease in its population over the past decade as nearly every region reported some level of retraction from 1991 to 2001. In contrast, over this same

period the total population of Ontario grew by approximately 13%. While the Ministry of Health and Long-Term Care indicate that Northwestern Ontario's population will continue to decline and then level off in the future<sup>2</sup>, Northern governments and industries are continuing to address the impacts of population decline while working to strengthen the North and its communities.

**Table 1: Land area of the pan-Northern (NOBI) regions**

Region	Land area (square kilometers)
North Bay/Nipissing/Muskoka	44,000
Sault Ste. Marie/Algoma	49,000
Sudbury/Manitoulin/Parry Sound	55,000
Thunder Bay/Northwestern Ontario	525,000
Timmins/Cochrane/Temiskaming	149,000
<b>Total NOBI Area</b>	<b>822,000</b>
<b>Total Ontario Area</b>	<b>907,655</b>

**Table 2: Population and 10 year trend for the pan-Northern (NOBI) regions**

Region	Population (1991)	Population (1996)	Population (2001)	Change (percent from 1996)	Change (percent from 1991)
North Bay/Nipissing/Muskoka	n/a	n/a	136,000	n/a	n/a
Sault Ste. Marie/Algoma	127,269	118,567	118,567	-5.5	-5.5
Sudbury/Manitoulin/Parry Sound	235,000	242,000	228,000	-6.0	-3.0
Thunder Bay/Northwestern Ontario	240,555	n/a	234,760	n/a	-2.4
Timmins/Cochrane/Temiskaming	125,000	n/a	114,000	n/a	-10
<b>Total NOBI Area</b>	<b>n/a</b>	<b>n/a</b>	<b>831,327</b>	<b>n/a</b>	<b>n/a</b>
<b>Ontario (total)</b>	<b>10,097,385</b>	<b>10,753,573</b>	<b>11,410,046</b>	<b>+6.1</b>	<b>+13</b>

**Demographics**

Consistent with national trends, Northern Ontario is experiencing an aging of its population. For instance, in the Algoma district individuals aged 75-84 years and 85 and over increased by 17.7% and 22.8%, respectively between 1996 and 2001. The pan-Northern region is also experiencing significant youth out-migration. In the Algoma district, individuals aged 15-19, 20-24 and 25-44 years have decreased by 5.6%, 18.5% and 16.4% respectively, between 1996 and 2001. One explanation for the youth out-migration may be the lack of job availability and innovative career opportunities in the region. Unfortunately, many of Northern Ontario's youth have left for the more robust and growing communities throughout Canada. The inception of more knowledge-based industries and companies in the NOBI region would provide youth with the incentive to remain in the region.

<sup>1</sup> Statistics Canada, Census 2001

<sup>2</sup> Northwestern Ontario Long-Term Care Annual District Service Plan, 2003

## 1.2.2 Physical Infrastructure Inventory

### **Total Land Available for Commercial Development**

Within its vast area, Northern Ontario has many parcels of land suitable for commercial and industrial development. There are a number of parks and developments that provide both serviced and non-serviced lots in a variety of locations within each of the regions. Many of these have been identified in the individual regional innovation profiles prepared by each region. In addition, lands are typically available at desirable locations within the urban centres and such availability is an asset for the region.

### **Research Parks/Commercialization Centres/Incubators**

The pan-Northern region maintains several established research parks and commercialization centres, which are mainly located within close proximity to the major urban centres. A table listing some of the reported centres is provided below. In addition, throughout the pan-Northern area there are a number of business mentorship and support organizations specific to each region. These organizations include economic development offices and various regional business mentorship initiatives (Table 3).

**Table 3: Selected Lands/Research Parks/Commercialization Centres/Incubators**

Region	Asset	Description
North Bay/Nipissing/Muskoka	Available lands	North Bay has identified the availability of 600 acres of serviced industrial land, as well as 70 acres of airside property at the airport. Bracebridge has identified 150 acres.
Sault Ste. Marie/Algoma	Sault Ste. Marie Innovation Centre (SSMIC)	Assists small biotechnology related businesses get established through enrolment in SSMIC business incubation program. Networks small biotechnology related businesses and will provide links to ScienceWorks
	Great Lakes Forestry Centre (GLFC)	GLFC has provided incubator services to previous ventures
	ScienceWorks	ScienceWorks is a commercialization centre that could

	ULERN	provide incubation space to a variety of initiatives  ULERN could provide office space and administrative support to a variety of biotechnology initiatives
Sudbury/Manitoulin/ Parry Sound	Northern Centre for Advanced Technology Inc. (NORCAT)	Provides start-up office space and use of facilities through its Residency Program.
	The Sudbury Centre for Innovation and Technology (SCITech)	Privately owned technology centre located in the Greater City of Sudbury. It has over 42,000 square feet of space to accommodate high technology companies
	Laurentian University	Significant parcels of land are available on campus and are close to existing research activities related to mining and health, such as MIRARCO, NEUREKA, the Northeastern Ontario Regional Cancer Centre, Sudbury Regional Hospital, St Joseph's Longterm Care Facility, and the Northern Ontario Medical School
Thunder Bay/ Northwestern Ontario	Innova Business Park, Thunder Bay	71 Prime acres within the Intercity, cleared and ready for development, fully serviced including optic lines; phase 3 power; water/sewer infrastructure, natural gas; and street lighting
	Mission and McKellar Islands, Thunder Bay	Heavy industrial uses, approximately 40% of the islands are undeveloped
	Airport Land, Thunder Bay	2.5 acre parcel, recommended for commercial use
	Waterfront Business Park, Thunder Bay	No data available at this time
	"Harbour Park" Industrial District, Thunder Bay	150 acres (approximately 30% developed/leased, zoned for heavy industry
	Fort William First Nation Commercial Park, (vicinity of Thunder Bay)	No data available at this time
	Jones Road Site Industrial Park, Kenora	20 acre site, fully serviced

Timmins/Cochrane/ Temiskaming	Available land	1000 acres available for development
----------------------------------	----------------	---

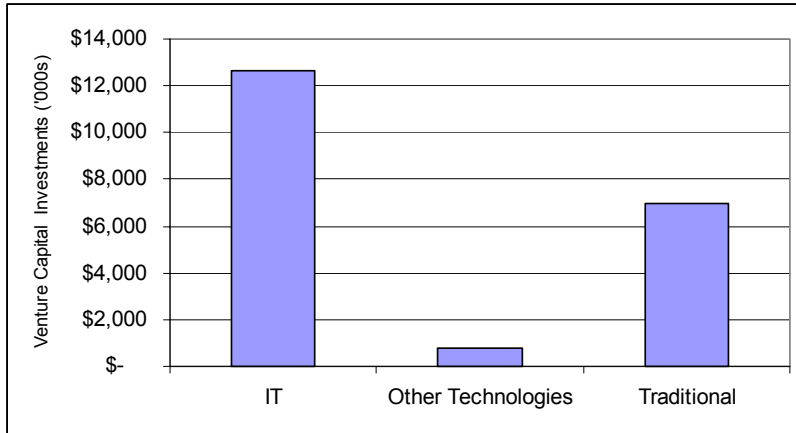
### **1.2.3 “Soft” Commercialization Infrastructure**

#### **Venture Capitalists (VC) Activity**

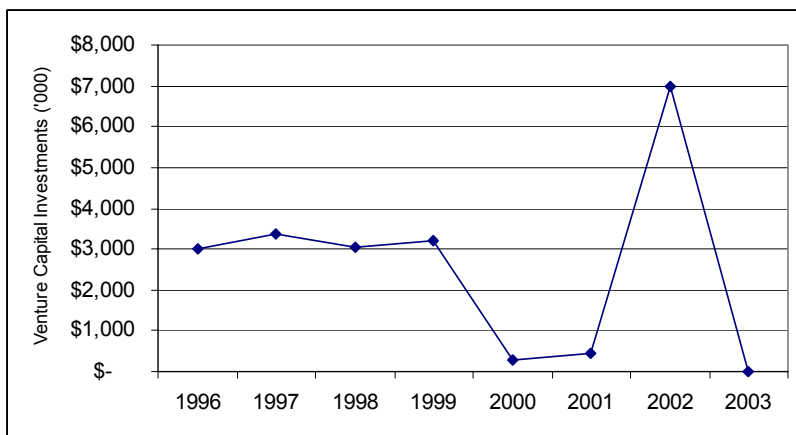
The pan-Northern region has recorded a limited amount of venture capital investment from 1996 to 2003 compared to the national and provincial (Ontario) levels which were \$19.8 and \$10.2 billion, respectively, over the same time period. Overall, venture capital activities throughout Northern Ontario tend to occur in a regional and sporadic manner. This does not imply that investment mechanisms are not in place, but may reflect a general lack of formalized accounting. A total cumulative investment of \$20.4 million (1996 to 2003) was recorded in Northern Ontario, across all sectors<sup>3</sup>. A breakdown of these investments by year (figure 2) and by sector (figure 3) is also included. This data indicates that information technology (IT) was a dominant sector of regional investment. Also evident from this data, but not shown, was that Sault Ste. Marie and Elliot Lake were centres of high venture capital activity. It should be noted that sources of venture capital are available throughout the region, such as the Business Development Bank of Canada (BDC). The BDC’s venture capital unit is able to invest in a variety of opportunities and, in fact, the BDC’s largest VC sector is biotechnology at about 27%.

---

<sup>3</sup> [www.cvca.ca](http://www.cvca.ca)



**Figure 2:** Venture capital investments (all sectors) recorded for Northern Ontario (1996 – 2003)



**Figure 3:** Venture capital investments across sectors for Northern Ontario (1996 to 2003)

Throughout the pan-Northern region the small business sector is well supported by a network of business mentorship and financial support organizations. One example is the Community Futures Development Corporations (CFDCs) which provide business services and maintain investment portfolios. Currently, 24 communities throughout Northern Ontario region maintain CFDCs which, through Industry Canada and FedNor, can provide repayable financing of up to \$125,000 on commercial terms through loans, loan guarantees or equity investments. A new funding pool for CFDC's in Northern Ontario can support investments up to \$500,000. In addition, the region is also supported by the FedNor program which can provide funding to not-for-profit initiatives and to various economic development and industry associations.

### **Other Financing Mechanisms**

The number of funding resources available to Northern Ontario is clearly an important advantage to the region. Additional examples of these financing programs include, but are not limited to:

- The **FedNor Applied Research and Development Program** which is targeted to SMEs. Both patenting and marketing costs are eligible under this program. All assistance is normally repayable. Contributions to non-profit organizations will be deemed non-repayable unless revenue streams may be generated from the project to allow for repayment. FedNor's contributions will normally not exceed 50% of eligible costs to a maximum contribution of \$500,000.

- The **Industrial Research Assistance Program (IRAP)** is designed to help small and medium-sized enterprises (SMEs), with 500 employees or less, meet the unique challenges they face in the research and development of new products, processes and services. IRAP offers a range of services designed to help SMEs access key resources, expert advice, new technologies, testing facilities, and financial assistance in order to develop innovative ideas. Contributions available through the IRAP program include:
  - IRAP may fund up to 50% of certain project research and development costs. Depending on the complexity of the project, funding generally ranges from \$5,000 to a maximum of \$350,000;
  - Through the IRAP-TPC Precommercialization Assistance collaboration, IRAP Industrial Technology Advisors (ITAs) are able to offer refundable contributions to firms to support the various activities required to improve their technological competitiveness. Total eligible project costs under IRAP-TPC Precommercialization Assistance may not exceed \$1,500,000. (Note: Projects with total eligible costs in excess of \$1,500,000 will be referred to TPC for consideration);
  - Innovation Insights program provides an exclusive opportunity to fully explore the origins and applications of trend setting Best Practices;
  - The Technology Visits Program provides senior executives a hands-on opportunity to see the latest manufacturing technologies and innovative methods proven successful by leading-edge companies across Canada;
  - The Technology Inflow Program (TIP) has a domestic and international component and is designed to assist Canadian SMEs access Canadian or foreign technology and helps develop R&D partnerships. TIP funding is based on cost-sharing principles and covers costs associated with domestic/international travel. Support for specific TIP projects will not normally exceed \$10,000;
  - The Industry Energy Research and Development (IERD) program supports the development and use of new energy-efficient processes, products, systems and equipment proposed by industry. The average level of IERD's repayable contribution is 35 percent of total project costs; and
  - The Renewable Energy Technologies Program (RETP) supports efforts by Canadian industry to develop and commercialize advanced renewable energy technologies, such as active solar, wind power, bioenergy and small hydro with industry that can serve as cost-effective and environmentally responsible alternatives to conventional energy generation. RETP's funding is repayable.
- The **Northern Ontario Heritage Fund Corporation (NOHFC)** may provide funding to not-for-profit projects. It is also understood that NOHFC is currently considering "re-opening the doors" to some form of assistance to the private sector.
- **Northern Ontario Grow Bonds:** The Ontario government recognizes the importance of economic tools that help small and medium-sized enterprises thrive and create jobs and incomes. To this end, the Province is moving forward on its commitment to establish a Northern Ontario Grow Bonds program that would foster small and medium-sized business development. In 2004-05, the government proposes to establish a pilot program to issue provincially guaranteed bonds and use the proceeds to provide loans to new and growing businesses in northern communities. The Northern Ontario Grow Bonds pilot project would allow northern Ontario residents to invest in their communities. The proceeds of provincially guaranteed Northern Ontario

Grow Bonds would be loaned to eligible small and medium-sized businesses in the north to strengthen and diversify the local economy.

- The **Northeast Investment Pool** (affiliated with the CFDCs) has invested over \$7 million in 18 projects ranging from the resource sector to manufacturing and tourism since its inception in June 2001. The pool enables a CFDC to invest in a business at a level higher than the normal \$125,000 limit, through a sharing of risk and potential returns with other CFDCs.
- The **Nickel Basin Federal Development Corporation (Sudbury)** has granted close to \$4.9 million on 98 small business loans since its inception in 2000. The average success rate for loan applicant is just over 60%<sup>4</sup>. Loan activities of chartered banks are not disclosed, but loan approval criteria are the same across the province and approval is on a case-by-case basis.
- In the North Bay area, a group is attempting to create a **Merchant Bank** that would be active in “mezzanine” financing. Such financing is not directed at high-risk start-ups but at well-established smaller firms that have assets and require funds for expansion. It would also be a vehicle that would be able to accommodate larger deals, up to \$25 million, that could occur if a non-local owner (multinational) were seeking to dispose of a company located in the area.
- It should be noted that traditional commercial financing is readily available throughout the region and is supported by a solid network of chartered banks.

### **Angel Investor Network**

Attempts have been made in all regions to identify angel investor activity. Typically, angel investments are sporadic and are difficult to quantify due to a lack of formalized reporting. Although some attempts have been made to create structured angel investor networks, few appear to exist in Northern Ontario (or wish to be identified). It is acknowledged that angel investment activity is likely present across the pan-Northern regions, but structured networks have yet to be established. Anecdotally, there are reports of angel investors that have provided equity funding to a number of technology and biotechnology companies in Northern Ontario.

### **Tax Incentives**

Several tax incentives are in place to stimulate the economy and several are specific to research and technology activities within Northern Ontario. For instance, initiatives in Northern Ontario are able to access several tax incentive programs, which include:

- **Ontario Innovation Tax Credit (OITC)**: Public and private corporations can receive a tax credit for scientific research and experimental development carried on in Ontario.
- **Workplace Accessibility Tax Credit (Ontario Ministry of Finance)**: Provides a refundable tax credit of 15 percent of the total amount of expenditures incurred after July 1, 1998, for employers who hire a new employee with a disability.
- **Ontario Focused Flow - Through Shares (OFFTS) Tax Credit (Ontario Ministry of Finance)**: Intended to stimulate mineral exploration in Ontario and to improve access to capital for small mining exploration companies.
- **Scientific Research and Experimental Development (SR&ED) Program**: The federal government provides income tax incentives to Canadian taxpayers that conduct scientific research and experimental development (SR&ED). It is the largest single source of federal government support for industrial research and development.

---

<sup>4</sup> Nickel Basin Federal Development Corporation

- **Graduate Transition Tax Credit (Ontario Ministry of Finance):** A refundable tax credit to encourage businesses to provide work opportunities to unemployed post-secondary graduates.
- **Co-operative Education Tax Credit:** To help create employment opportunities by providing employers operating unincorporated businesses with a refundable tax credit for hiring post-secondary education students.
- **Ontario New Technology Tax Incentive (ONTTI):** The ONTTI encourages the development and transfer of new technology by helping to create increased access to the latest technology. Provides an immediate 100 per cent income tax deduction of the cost of eligible Intellectual Property acquired by a corporation from an unrelated person for the purpose of implementation in a business of the corporation that is carried on in Ontario. Qualifying Intellectual Property includes: a patent (domestic or foreign), a license, a permit, know-how, a commercial secret or other similar property constituting knowledge, but not a trademark, an industrial design, a copyright or other similar property constituting the expression of knowledge.

#### **1.2.4 Business and Economic Development**

##### ***Business Mentorship and Support Associations***

Many regions and centres across Northern Ontario maintain local Economic Development Corporations and Chambers of Commerce. These organizations promote economic development and respond to regional issues and are active in representing the interests of the business community. To illustrate the nature of the regional mentorship and support organizations a few specific examples are highlighted:

- The **North Bay and District Chamber of Commerce** has recently implemented an Export Development Program that compliments the business programs of Nipissing University and Canadore College which assist in the development of small business through business planning and development services.
- **The Business Centre** in Nipissing Parry Sound provides one-on-one consulting and mentoring to over 1,500 clients annually throughout the districts of Nipissing and Parry Sound. Services include Market Research assistance, Technology transfers, business planning and financial structuring. The Centre is a Canadian Technology Node member and the host organization for Industry Canada's Annual Innovation Forums that are held at Nipissing University.
- **The Timmins Business Enterprise Centre** offers a walk-in resource library of business information with a knowledgeable business consultant. Services range from providing advice with the preparation of a business plan, information on rules and regulations, to raise awareness of federal and provincial government assistance programs and other financial sources.
- In Northwestern Ontario there are a number of business mentorship and support organizations within the various communities. Support organizations include, but are not limited to, the **City of Thunder Bay's Tourism and Economic Development Office ("TED")**, **Northwestern Ontario Technology Centre (NOTC)**, and the **Thunder Bay Community Mentoring Program**. TED has a number of programs where it assists businesses who are expanding or developing business plans, etc.



NOTC is an incubation centre for technology companies and provides management expertise, administrative services, as well as mentoring, to its tenants. Thunder Bay Community Mentoring Program is an organization that assists all types of businesses in start up by providing mentorship opportunities for the new owners.

- The **Regional Business Centre** and the **Greater Sudbury Chamber of Commerce** co-manage a business mentorship program that provides counseling with an experienced business owner in the City of Greater Sudbury. The Regional Business Centre has an integrated enterprise centre that has made about 6,000 client contacts in 2003.
- Sault Ste. Marie and Algoma district maintains several business mentorship activities, which include: the **Sault Ste. Marie Economic Development Corporation** (SSMEDC), **Sault Ste. Marie Innovation Centre** (SSMIC), and the **RAPIDSUCCESS Business Growth Association**, to name a few.

### ***Scientific Associations, Outreach & Networking Programs***

There are a number of scientific associations operating in Northern Ontario, however most tend to operate in a regional manner. Often the regional economic development corporations will include activities relating to science and technology. Some of these associations include:

- The Greater Sudbury Development Corporation (GSDC) has played an instrumental role in supporting biotechnology in the Greater Sudbury area. In 2003, life science stakeholders were brought together during the GSDC strategic planning session to form a network and identify goals and key issues that were needed to grow this sector. Other prominent groups within Sudbury include the **Northern Centre for Biotechnology and Clinical Research** (NEUREKA!).
- The **Knights Program** is offered to its tenants by the Northwestern Ontario Technology Centre and acts a business networking program centred in Thunder Bay but servicing the Northwestern Ontario community.
- The **Great Lakes Forest Alliance** and the **Upper Lakes Environmental Research Network** (ULERN) facilitate and promote collaborative environmental and natural resources research, development, and communication. Both are based in Sault Ste. Marie.
- **Lakehead Life Sciences Association (LLSA)**, located in Thunder Bay, this new association is responding to the needs of the growing life sciences community in Northwestern Ontario. The goals are to support, encourage and the guide the current and future development of a regional life sciences cluster. Initiated by Lakehead University, the LLSA will be a resource for developing policy, providing thought-leadership, and strategic planning for academic, government, not-for-profit, and private sector initiatives.\
- **The Northwestern Ontario Development Network** is an incorporated organization that consists of 19 full and 11 affiliate members. The Network is a window into economic development in Northwestern Ontario. With financial assistance from Industry Canada/FedNor, Ministry of Northern Development and Mines, membership revenues and projects, the Network has been able to help the communities of

Northwestern Ontario take control of their own economic planning and exercise bottom-up decision-making.

- **ScienceWorks!**, based in Sault Ste. Marie, is an innovative biotechnology centre that is currently in development. Some of the objectives include:
  - Diversifying the economy of Sault Ste. Marie and Northern Ontario
  - Developing science related education and training opportunities
  - Assisting in the creation of new science based enterprises
  - Public involvement and outreach
  - Enhancing the biotechnology profile and image of Sault Ste. Marie and Northern Ontario

### ***Demonstrated Commitment by Industry and Community***

Through funding, collaborations and volunteerism, Northern Ontario industries and communities have shown a commitment to further developing knowledge-based industry in the region. Over the last few years, the communities have been working together to develop ideas and plans to further enhance the knowledge-based industry. Examples include, but are not limited to:

**Sault Ste. Marie** is actively becoming a leader in applying innovative technologies to utilize bio-product streams of local industry. For instance, the local economic development corporation has been working with a client to try to establish a 50,000 square foot facility. The company is in the early stages of applying its technology to convert municipal and commercial solid wastes into energy without toxic emissions or significant greenhouse gases. The company's technology utilizes steam reforming to produce usable carbon and hydrogen derived from waste feedstock. They estimate that the new facility will divert 20 tonnes of waste production per day.

Other examples include NORCAT in **Sudbury** which works with the private and public sector as an economic development agent through the deployment technology.

In **Thunder Bay**, the NWO Innovation Team (I-Team) was established to facilitate the creation of new knowledge in Northwestern Ontario. The I-Team is made up of government, academic, community and other interested stakeholders throughout Northwestern Ontario. There have been significant community and industry donations contributed towards the construction of new infrastructure, such as the Thunder Bay Regional Health Sciences Centre, Lakehead University's state of the art ATAC Centre, and Confederation College's Aviation Centre. Evidence of this commitment includes the approval by the Council of the City of Thunder Bay for the development of the Biotechnology Marketing, Innovation and Development Fund. The City Council has approved \$150,000 with potential contributions from other senior levels of government to bring this fund to a projected value of \$650,000. This fund supports initiatives that would further develop the Thunder Bay's emerging biotechnology cluster.

### ***Existing Economic Development/Innovation Plans***

Appendix 1 lists sources of various regional economic development plans.

## 1.3 Industry Profile

### 1.3.1 Total Employment, Unemployment, and Employment by Industry Sector

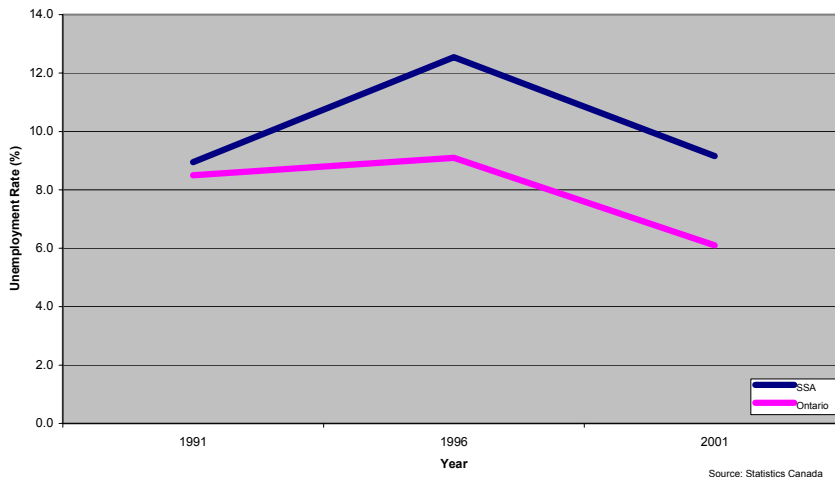
The pan-Northern region employs 396,355 individuals which represents 6.6% of Ontario's workforce. The overall unemployment rate of 9.5% in 2001 was higher than the provincial average of 6.1%. A breakdown of the employment numbers and

**Table 4: Total Regional Employment**

Region	Labour Force (2001)	Unemployment Rate (2001)
North Bay/Nipissing/Muskoka	61,305	8.7%
Sault Ste. Marie/Algoma	53,915	10.1%
Sudbury/Manitoulin/Parry Sound	113,015	9.2%
Thunder Bay/Northwestern Ontario	116,665	9.2% <sup>5</sup>
Timmins/Cochrane/Temiskaming	51,455	11.1%
Pan Northern total	396,355	9.5%
Ontario (total)	5,992,765	6.1%

and unemployment rates is indicated in table 4. The unemployment trends for the Sudbury/Manitoulin/Parry Sound area is provided within the context of provincial trends (below). The Sudbury area statistics indicate that the unemployment trends of the region mirror those of the province. This data set is broadly reflective of the overall trends observed across Northern Ontario and therefore serves as a regional representative.

1991, 1996, and 2001 Unemployment Rates for the Sudbury Study Area



**Figure 4:** Unemployment rates for the Sudbury study area, which reflect the overall trend throughout the NOBI region.

Recent trends in Northern Ontario have shown some diversification in the economy in that retail trade, health and social services, education, tourism, construction and industrial supplies have become major employers. The North American Industry

<sup>5</sup> Employment Rate is for Thunder Bay, which may reflect the overall North Western Ontario region

Classification System (NAICS) identifies 20 major industry sectors as indicated in table 5.

**Table 5:** Total employment statistics for Northern Ontario across job classification (NAICS)<sup>6</sup>

Sectors (NAICS classification)	# employed in Ontario	Jobs in Northern Ontario	Location Quotient (LQ) - Jobs in Northern Ontario
All industries	5,252,735	<b>309,210</b>	
44-45 Retail trade	621,625	<b>43,330</b>	1.18
62 Health care and social assistance	491,650	<b>39,885</b>	1.38
31-33 Manufacturing	909,710	<b>35,205</b>	0.66
72 Accommodation and food services	345,055	<b>26,875</b>	1.32
61 Educational services	340,835	<b>25,385</b>	1.27
91 Public administration	294,265	<b>24,385</b>	1.41
81 Other services (except public administration)	243,390	<b>15,215</b>	1.06
48-49 Transportation and warehousing	212,825	<b>14,645</b>	1.17
23 Construction	162,850	<b>10,780</b>	1.12
21 Mining and oil and gas extraction	18,200	<b>10,755</b>	10.04
56 Administrative and support waste management and remediation services	184,330	<b>10,260</b>	0.95
54 Professional scientific and technical services	382,115	<b>10,235</b>	0.46
52 Finance and insurance	279,605	<b>8,355</b>	0.51
11 Agriculture forestry fishing and hunting	109,915	<b>7,855</b>	1.21
41 Wholesale trade	251,005	<b>7,855</b>	0.53
71 Arts entertainment and recreation	103,055	<b>5,545</b>	0.91
51 Information and cultural industries	152,880	<b>5,340</b>	0.59
53 Real estate and rental and leasing	99,950	<b>4,270</b>	0.73
22 Utilities	41,970	<b>2,890</b>	1.17
55 Management of companies and enterprises	7,515	<b>140</b>	0.32

*Note: Northern Ontario includes: Nipissing District (3548), ParrySound District (3549), Sudbury District (3552), Greater Sudbury Division (3553), Timiskaming District (3554), Cochrane District (3556), Algoma District (3557), Thunder Bay District (3558).*

The total number of jobs in each major NAICS category is indicated for Northern Ontario and is compared to total employment numbers for Ontario. The data is sorted according to the sector of greatest employment. Retail trade, health care and social assistance, and manufacturing provide the greatest number of jobs for the pan-Northern region and represent 14%, 12.8% and 11.3% of the total employment, respectively. The location quotients<sup>7</sup> for employment by industry and occupation were calculated according to Statistics Canada categories used in the 2001 Community Profiles. The location quotients for these top three major sectors are modest and indicate that these sectors provide substantial jobs in Northern Ontario, but are not highly concentrated in the

<sup>6</sup> MEDT data, Statistics Canada 2001

<sup>7</sup> Location quotients represents the degree to which the region specializes in an industry or occupation compared to the province.

region relative the rest of Ontario. Therefore, to determine the relative job strengths of Northern Ontario the sub-categories of each major category were sorted on the basis of location quotient. In the analysis, sub-categories containing less than 1000 jobs were eliminated and only subcategories with location quotients greater than 1.5 are shown (Table 6).

<b>Sectors (NAICS classification)</b>	<b>Location Quotient (LQ) - Jobs in Northern Ontario</b>	<b>Jobs in Northern Ontario</b>
2122 Metal ore mining	15.44	8,905
1133 Logging	12.25	2,730
1153 Support activities for forestry	11.75	1,325
3211 Sawmills and wood preservation	11.22	5,950
9141 Aboriginal public administration	10.61	2,285
3221 Pulp paper and paperboard mills	10.11	9,265
3212 Veneer plywood and engineered wood product manufacturing	8.90	3,210
2131 Support activities for mining and oil and gas extraction	8.16	1,105
3314 Non-ferrous metal (except aluminum) production and processing	6.37	1,505
7212 RV (recreational vehicle) parks and recreational camps	5.24	1,550
4821 Rail transportation	4.71	2,285
3311 Iron and steel mills and ferro-alloy manufacturing	3.06	3,965
3331 Agricultural construction and mining machinery manufacturing	2.46	1,070
5614 Business support services	2.32	4,025
9120 Provincial and territorial public administration (9121 to 9129)	2.32	8,020
4471 Gasoline stations	2.24	2,700
6214 Out-patient care centres	2.18	2,475
2313 Engineering construction	2.16	2,655
4854 School and employee bus transportation	2.06	1,570
4842 Specialized freight trucking	2.04	1,825
7211 Traveller accommodation	2.02	5,485
6112 Community colleges and C.E.G.E.P.s	2.00	2,685
6241 Individual and family services	1.96	3,775
6216 Home health care services	1.61	1,390
7224 Drinking places (alcoholic beverages)	1.57	1,095
4172 Construction forestry mining and industrial machinery equipment and supplies wholesaler-distributors	1.56	1,740
6220 Hospitals (6221 to 6223)	1.53	14,200

<sup>8</sup> MEDT data, Statistics Canada 2001

It is evident that natural resources, specifically mining and forestry, and the affiliated support and processing industries are the major employment strengths of Northern Ontario relative to the rest of Ontario. Though differences in the location quotients exist between the 5 regions of NOBI the overall conclusions presented in tables 5 and 6 represent the major trends of the pan-Northern region. Employment data specific to each region is provided in Appendix 2, which lists the major employers of the region.

**Average Wage Rates**

Wage rates vary across Northern Ontario but tend to fall below provincial averages. For instance, Based on the 2001 Census, average earnings in each of Kenora, Rainy River and Thunder Bay Districts were \$29,642, \$28,906 and \$32,010 respectively, all of which were lower than the provincial average of \$35,185. Average wages in various occupations are also generally lower than the provincial average. The average wage rates are for the pan-Northern region are indicated in table 7 (\$/hr).

<b>Industry sector</b>	<b>Average wage rate*</b>
Agriculture and other resource based industries	\$16.01
Business services	\$16.72
Finance and real estate	\$17.25
Health and education	\$23.08
Manufacturing and construction industries	\$19.35
Wholesale and retail trade	\$11.92

**1.3.2 Major Sector: The Mining Industry**

In 2000, mining production, development, and exploration accounted for \$6.171 billion of economic activity to the Ontario economy. Throughout Northern Ontario mining provides 10,715 jobs in mining activities and 7,680 in metal manufacturing. This cluster of expertise is evident from location quotients of some mining activities (15.44 – metal ore mining, 3.06 – iron and steel mills and ferro-alloy manufacturing). This activity is conducted in a small area within Ontario (about 0.01 percent of the provincial landmass)<sup>9</sup>. Sudbury is Canada’s major mining centre. The nickel, copper, cobalt, platinum, palladium and gold deposits in the footwall produce some of the earth’s most valuable ore. Total reserves, both mined and existing mineral resource inventory, in the Sudbury area are estimated at over 1.6 billion tonnes of ore. The historical production has been reported to be in excess of 8.4 million tonnes of nickel metal and 8.3 million of copper metal<sup>10</sup>.

<sup>9</sup> Ontario Smart Growth, Shape the Future, Northeastern Ontario Smart Growth Panel

<sup>10</sup> Institute for Northern Ontario Research and Development

### **Inco**

Inco Limited in Sudbury, with about 4500 employees, produces about 20% of the total global nickel demand. Its operations in Sudbury are the largest fully-integrated mining, milling, smelting and refining complex in Canada and one of the largest in the world. Sudbury is also the birthplace of Inco, where the company's operations began in 1902. Inco's products include nickel, copper, precious metals, platinum-group metals, sulphuric acid and liquid sulphur dioxide. The company owns numerous mines in the area, which include Coleman, Copper Cliff North, Copper Cliff South, Crean Hill, Creighton, Froid, Garson, Gertrude, McCreedy East and Stobie. Inco's 2003 revenue as a whole was US\$2.4 billion. There are 4,425 employees in the greater Sudbury area representing 42.5% of Inco's work force. Inco is expecting a 7.5% increase in nickel output for 2004 and expects demand will outstrip production for several years to come. The average wage for employees is estimated at \$26.02 per hour and was increased to \$26.41 per hour on June 1, 2004.

Inco has a staff of 30 employees engaged in research activities in the greater Sudbury area. Mines Research is spread throughout three locations in the City of Greater Sudbury. It includes the main offices of Mines Research group in Copper Cliff, a Research Mine located adjacent to the Copper Cliff North and the Mines Operation Centre. The Mines Research group is mandated to develop and transfer technology and process innovations contributing to improvements in safety, productivity and costs in the areas of: mining and process improvements, automation and tele-operation and decision support systems. Mines Research employs researchers, specialists and project supervisors, as well as a multi-skilled team of research miners involved in testing prototype equipment and processes as well as a core group of tele-mining operators.

### **Falconbridge**

Sudbury is part of Falconbridge Integrated Nickel Operations (INO). The company has been mining nickel-copper ores in the Sudbury area since 1928. The operations employ 1,488 people and consist of underground mines, a mill and a smelter. These facilities are spread throughout the 90-kilometre-wide oval-shaped geological formation known as the Sudbury Basin. Nickel and copper are the primary metals but the operations also produce cobalt and precious metals.

Sudbury Mines/Mill operates four underground nickel/copper mines: Craig, Fraser, Lindsley and Lockerby. The Craig mine is Sudbury's largest and newest. In 2002, Falconbridge produced about 43 percent of the total ore output from the Sudbury area. The Strathcona mill receives ore from four mines and produces two concentrate streams – a nickel-copper concentrate that goes to the Sudbury Smelter for smelting and a copper concentrate that goes to the Kidd Metallurgical Division for toll refining. The mill has a capacity of approximately three million tonnes of ore per year. The processing facilities operated by the Sudbury Smelter include a smelter and a sulphuric acid plant. The Sudbury Smelter smelts nickel-copper concentrate from the Sudbury and Raglan mines and processes custom feed materials. It is capable of producing 130,000 tonnes of nickel-copper matte annually. The smelter's electric furnace converts the mineral concentrate into a high-grade matte containing nickel, copper, cobalt and platinum group metals. The smelted and granulated matte is sent by rail to Quebec City, and then shipped overseas to Falconbridge Nikkelverk in Norway for refining into pure metals. Falconbridge's 2002 Integrated Nickel Operations revenue was US\$1.088 billion. It

employs 1,458 employees in the Sudbury study area representing 22.8% of all employees. Falconbridge captured 8% of the global nickel market in 2002.

The **Timmins** area is also a leader in the Canadian mining industry and has successfully maintained a balance between industry and the ecology. Mining in the City of Timmins is at the heart of the City's economic base and the local region hosts a diversity of precious metals (gold, silver, platinum and palladium), base metals (nickel, copper, and zinc), and industrial minerals (talc). Currently there are more than 9600 jobs in the city of Timmins related to the mining sector - 2,774 are direct jobs.<sup>11</sup> Some the major projects and operations are briefly outlined.

#### **Porcupine Joint Venture:**

One of the city's major mining operations is the Porcupine Joint Venture (PJV). The PJV is the joint venture between Placer Dome LTD. and Kinross Gold Corporation. This cooperative project launches an aggressive exploration program in the Porcupine Camp, which includes the properties of Hoyle Pond Mine, Pamour, Nighthawk Lake, Bell Creek, Hollinger, McIntyre, Hallnor, Preston and Paymaster.<sup>12</sup> Currently the PJV employs approximately 580 workers in their open pit and milling operations.<sup>13</sup> In 2003, the PJV is expected to produce 443, 000 ounce of gold.<sup>14</sup> Based on the current reserve the PJV will be operating in the community until 2012. Underground operations closed in 2004. Current activities include:

- Recently announced a \$700 million dollar expansion of the Pamour Pit
- These plans involve the doubling of the size of the current pit, extending it across Highway 101 East through 25 per cent of Three Nations Lake.

#### **Falconbridge Ltd. Kidd Creek Division:**

Falconbridge's Kidd Creek Division is of one the world's premiere copper-zinc mining and metallurgical facilities. In addition to these metals, Kidd Creek also produces indium, cadmium, silver and sulphuric acid.

The operations are organized into two independent business units, the Kidd Creek Mining Division and the Kidd Creek Metallurgical Division. The Kidd Creek Mining Division is focused on developing and sustaining economic mining plans, while the Kidd Creek Metallurgical Division is concentrating on further establishing itself as a custom feed processing facility. The two divisions employ more than 1,400 people.<sup>15</sup>

- A \$640 million investment in the Kidd Mining Division by Falconbridge Limited shows the confidence of the multinational mining company in the quality and quantity of the Timmins' ore body. The project is expected to create up to 220 contract positions through the development stages and to maintain 400 positions at the mine to at least the year 2020 <sup>16</sup>.

#### **Falconbridge Montcalm Project**

---

<sup>11</sup> Mayor Jamie Lim, Timmins Year End Report-2002, [www.jamielim.com/reports/2002yearend.htm](http://www.jamielim.com/reports/2002yearend.htm)

<sup>12</sup> Placer Dome LTD. [www.placerdome.com](http://www.placerdome.com)

<sup>13</sup> Placer Dome LTD. [www.placerdome.com](http://www.placerdome.com)

<sup>14</sup> Placer Dome LTD. [www.placerdome.com](http://www.placerdome.com)

<sup>15</sup> [www.falconbridge.com](http://www.falconbridge.com), June 11<sup>th</sup>, 2003

<sup>16</sup> Falconbridge, Kidd Mining Division, Press Release July 19, 2000



Falconbridge Limited anticipates opening a new mine in Montcalm Township, about 90 km west of Timmins. Known as the **Montcalm Project**, this nickel deposit has a mineral resource estimate of 5.1 million tons grading 1.46% Ni and 0.71% Cu. When developed, Falconbridge is forecasting an annual production rate of 750,000 tonnes of nickel per year for approximately 8 years.

The ore would be processed at the Kidd Metallurgical Site in Timmins. This project is anticipated to create 145 direct jobs and the company is expected to inject 705 million dollars into the local economy by the end of 2011. Falconbridge has signed a purchase agreement with Outokumpu to obtain 100% interest in the property.

#### **Luzenac Inc.**

Luzenac Inc. operates a talc micronization plant in Timmins and an underground and open pit mining operation in Penhorwood Township. Reserves are estimated at 7 million tons grading 47.5% talc. Combine the expected increase in world demand for talc with the high purity of the Penhorwood deposit and the future of the talc mining industry in Timmins and area looks bright. The Penhorwood Mine employs a work force of 21 people and the Timmins milling operations employs 39 people.<sup>17</sup>

#### **Exploration in the Timmins Region**

The City of Timmins is one of the world's leading mining communities. Federal and provincial flow-through share programs for exploration expenditures have provided a much-needed boost to exploration activity in the area. Existing mines continue to conduct mine-site exploration and are extending the life expectancy of their operations. Initiatives such as **Discover Abitibi**, which "is to coordinate and direct an integrated geoscientific investigation of the Abitibi Greenstone belt of Northeastern Ontario"<sup>18</sup>, are also helping the exploration efforts in the City of Timmins. Since project inception there have been almost 9600 claims filed in the Discover Abitibi territory. The long-term results of this project are as follows:

- Increased exploration in the Timmins-Kirkland Lake area resulting from the production of high technology, leading edge geoscience products that will allow companies to explore in a more effective fashion than heretofore possible.
- A vibrant self-sustaining economy arising from the exploration work
- The discovery of new mineral deposits in the area.
- The development of new mineral deposits in the area.
- Baseline exploration data
- Technologies transferred to local institutions.
- Development of an increasingly skilled workforce, including the development of highly qualified people.<sup>19</sup>

Additional exploration highlights in the Timmins area include:

**De Beers Canada Exploration Inc.** continues to evaluate the **Victor Diamond Project**, located 90 km west of Attawapiskat in the James Bay Lowland. In the preceding years, De Beers had extracted a 10,000 tonne bulk sample of kimberlite for diamond evaluation. As of December 2002, De Beers Canada and the Attawapiskat First Nation

---

<sup>17</sup> MNDM, [www.mndm.gov.on.ca/mndm/mines/ims/pub/roa/roapdfs/OFR6113.pdf](http://www.mndm.gov.on.ca/mndm/mines/ims/pub/roa/roapdfs/OFR6113.pdf)

<sup>18</sup> Discover Abitibi: [www.discoverabitibi.com](http://www.discoverabitibi.com)

<sup>19</sup> Discover Abitibi: [www.discoverabitibi.com](http://www.discoverabitibi.com)

formally signed the Feasibility Partnering Agreement. This includes the framework for addressing environmental monitoring, health and safety issues on site, permitting, and business opportunities for the community.<sup>20</sup>

The Sheraton-Timmins Property has been a priority exploration focus for **Cross Lake Minerals Ltd.** since 1997. The Property is located 42 kilometres east of Timmins, Ontario in the Porcupine Mining Division. The Sheraton-Timmins Property is owned 100% by Cross Lake and consists of two mining leases (20 units); twenty-eight unpatented mining claims (286 units) and three patented lots (12 units) covering a total 5,093.8 hectares. The main focus on the property is the significant zinc-copper-lead-silver mineralization discovered while diamond drilling geophysical anomalies in 1997. Since then, Cross Lake has completed 80 diamond drill holes totaling 30,974 meters.<sup>21</sup>

As of January 2003, **Holmer Gold Mines Ltd.** has entered into an agreement with **Lake Shore Gold Corporation** to further develop its gold property in the City of Timmins. The property is located 18 kilometres west of Timmins and has a high-grade gold resource. The companies estimate that there is a minimum of 500,000 ounces of gold found on this property. Lake Shore Gold Corporation is expected to incur a minimum exploration expenditure of \$2,500 000. Once completed the company will retain 50% of the property with Holmer Gold Mines Ltd.<sup>22</sup>

#### **Mine Reclamation Projects in the Timmins Area**

The Timmins area is also active in remediation and reclamation of abandoned mine sites. Some of the current **mine reclamation projects** are briefly highlighted below:

**Kam Kotia**, an abandoned mine site near Timmins, is the largest of the mine rehabilitation projects being undertaken by the province of Ontario. Over the past few years, extensive work has been placed into this project. Between 2001 and 2003, \$14 million was spent on the site. The first two phases out of five have been completed. Phase 1 included the construction of diversion ditches, a containment berm, dam, and a lime treatment plant. Phase 2 included building an impoundment dam at the northwest section of the site and the closing of the area, which will eventually force the impoundment of the unimpounded tailings.

The former Kam Kotia mine site will benefit from the extension of the Abandoned Mine Rehabilitation (AMR) program. Originally the AMR program was to end in 2003, however, the government has agreed to extend the program for another four years with funding of \$21 million. Chris Hamblin, project co-coordinator for the AMR program, expressed that "a large portion of the money would be spent on cleaning up the abandoned Kam Kotia mine site. It has been estimated that it will cost approximately \$40 million to completely rehabilitate the 500 hectare mine site." Plans are to begin Phase 3 during late summer 2003 so that work can be done in winter using heavy equipment. Phase 3 will involve the relocation of the northeast tailings of the former copper-zinc mine to within a new impoundment dam.<sup>23</sup>

#### **The Red Lake Mining Centre**

---

<sup>20</sup> De Beers Canada, Media Release, December 12<sup>th</sup>, 2003

<sup>21</sup> Cross Lake Minerals Ltd. press release, October 19<sup>th</sup>, 2000

<sup>22</sup> Holmer Gold Mines Ltd., press release May 2003, [www.holmergold.com](http://www.holmergold.com)

<sup>23</sup> The Timmins Daily Press, Vol. 66 No 127, May 30<sup>th</sup>, 2003

Located in Northwestern Ontario, the Red Lake area is known for its high-grade gold deposits which are among some of the richest in Canada. In the region over three dozen mining companies, many with major partners are pouring millions of dollars into exploration in the Red Lake Gold area. For instance, Goldcorp Inc. has started sinking a 7,250 ft. deep shaft at its Red Lake Mine to increase gold production from 500,000 Troy ounces per year to 740,000 Troy ounces<sup>24</sup>. Goldcorp Inc.'s Red Lake Gold Mine is one of Canada's largest and lowest cost gold mining operations<sup>25</sup>. In addition, the Placer Dome Campbell Mine in the region has discovered a deep ore deposit and will initiate deepening their new Reid Shaft. In the near future, the Red Lake producers look toward 1,000,000 ounces of production per year.

Throughout Northern Ontario the mining presence has also allowed a mining supply and service industry to develop throughout the region. There are a number of engineering and consulting firms that support the mining industry and also operate on an international basis. Hatch, Golder Associates, Wardrop, Northland Engineering, Trow, and DST are a few of these companies active throughout the region.

### **North Bay Mining**

North Bay has 65 firms providing engineered products and services to the Global Mining market. They employ over 1,300 staff and have active applied research and development programs. The world's first fuel-cell powered locomotive for underground mining out tunneling was developed by a local firm. Four of the large multi-nationals have their headquarters in North Bay.

### **1.3.3 Major Sector: The Forestry Industry**

The forestry industry is an important natural resource for Northern Ontario and is also an important economic driver for the region. The forestry industry has developed into a complex network of activities that extends well beyond traditional natural resource harvesting activities. Forestry related activities range from manufacturing of value-added wood products to reforestation. For instance, ongoing reforestation efforts by the City of Timmins has attracted and retained major companies like Tembec Inc., Timmins Sawmill, Domtar (formerly McChesney Lumber), Grant Forest Products Inc., and Millson Timber Inc. Overall, the forestry activities in Northern Ontario can be divided by geographic location into two main sections: Northeastern Ontario and Northwestern Ontario.

#### **Northeastern Ontario**

Northeastern Ontario has a coniferous forest zone which includes black spruce, white spruce, jack pine, poplar, white birch, white pine, balsam and yellow birch are the most common trees in the community. In addition, to the significant forestry and logging activities, the region maintains major processing and manufacturing capacities for the forestry biomass. One of the major companies for fiber manufacturing is Tembec which is located in eastern Ontario and Quebec. In addition, Sault Ste. Marie/Algoma is a major centre of wood processing expertise and manufacturing and these industries are serviced by the excellent rail and port transportation links providing access to the USA. Adding to Algoma's cluster of forestry related industries is the internationally recognized

---

<sup>24</sup> <http://www.red-lake.com/html/welcome.html>

<sup>25</sup> <http://www.newswire.ca/en/releases/archive/March2004/12/c9764.html>

research capacity of the Great Lakes Forestry Centre and the Ontario Forestry Research Institute. Some of the major companies operating in Northeastern Ontario include:

**Abitibi-Consolidated** is a global producer of newsprint, and uncoated groundwood papers (value-added papers) with ownership interests in 27 paper mills in Canada, the United States, the United Kingdom and Asia (including its 50% interest in Pan Asia Paper Co.). Abitibi-Consolidated markets approximately 6 million tonnes of newsprint, and nearly 2 million tonnes of value-added papers. The Iroquois Falls location in Ontario employs 500 individuals and produces a total of 292,000 tonnes of paper product and includes 246,000 tonnes of newsprint and 46,000 tonnes of specialty paper.

**And Son Contracting** specializes in composting, wood waste disposal and adapting forestry by-product streams into growth mediums for soil treatment and bio-remediation. Located in Sault Ste. Marie, And Son Contracting employs 30 people.

**Columbia Forest Products** is an employee-owned company manufacturing products in 20 facilities throughout the United States and Canada. The products consist of hardwood plywood and laminated products and are sold through a network of wholesale distributors, mass merchandisers and major OEMs. The Hearst location employs approximately 300 employees.

**Domtar Inc.** is an integrated forest products company with operations in North America and Europe. Their business consists of 82% pulp and paper, 10% packaging and 8% lumber. The company is the second largest producer of uncoated free sheet in North America and the third largest in the world. The company also owns 50% of Norampac Inc., the largest Canadian producer of containerboard and corrugated containers. The company's 2002 annual report indicates it is allocating on a whole \$75 million dollars toward environmental matters. In Timmins, 2 divisions support lumber production. The Elk Lake Planning plant employs 110 with a 67,000 metric foot board measures (MFMB - 1,000 foot board measure) production. The company invested \$6 million in 2002 for equipment. The division located in Timmins employs 132 with a lumber production of 195,000 MFBM. The Espanola mill has a production capacity of 80,000 tonnes for paper and 350,000 tonnes for pulp and employs 790. Its cogeneration plant is 85% energy self-sufficient.

**G-P Flakeboard** processes wood fibre into manufactured products primarily for construction and manufacturing purposes. The company is a joint venture between Georgia Pacific Corporation and Flakeboard Company. This value of this alliance is estimated at \$100 million and employs 107 people. G-P Flakeboard adds to the strong processing capacity of the Sault Ste. Marie area.

**Grant Forest Products** maintains two operations, one in Englehart and the other in Timmins. Both operations produce oriented strand board (OSB) and the Englehart mill is the largest OSB production facility in the world<sup>26</sup>. Grant Forest Products has an employee-base of roughly 700 (including a smaller facility in Alberta).

**Norbord Industries** is a North American manufacturer of wood and wood composite panel products for construction and industrial use. With annual sales of more than US\$500 million, it is one of the largest producers of oriented strand board (OSB) in the

---

<sup>26</sup> [http://www.gfp-inc.com/aboutus/ourheritage\\_growth.htm](http://www.gfp-inc.com/aboutus/ourheritage_growth.htm)

world, and has a total capacity of 3.3 billion square feet (3/8" basis). Norbord currently operates 9 OSB, 1 medium density fiberboard (MDF), 1 Hardwood Plywood, 1 I-Joist and 1 sawmill in Canada and the United States. The company employs approximately 2,100 people. Norbord is a unit of Nexfor Inc., a public Canadian-based forest products company specializing in building materials and specialty pulp and paper in North America, and panelboard products in the UK. In 1996, Norbord invested \$9.5 million to expand the mill, install a new press and increase annual production by 60% to 480,000 square feet. They are using hardwood overlays such as birch, maple, red oak, cherry, knotty pine, mahogany, white ash and hickory, imported from southern Ontario, Quebec and the US. Norbord products are sold in Canadian and US markets. The mill employs 210 people.

**St. Mary's Paper**, located in Sault Ste. Marie, is one of the major companies operating in the Algoma district and helps form a cluster of pulp and process expertise and infrastructure in the area. St. Mary's Paper produces paper products and handles sludge and bio-solids. The company employs 430 people and is a community leader in developing eco-industrial linkages. For instance, St. Mary's paper is working in collaboration to develop innovative uses for the by-product and waste streams of the paper industry. This includes initiatives to utilize bio-solid wastes for soil treatment and bio-remediation following mining activities. In addition, bio-solids generated by St. Mary's milling operations are also being used to cap Provincial landfill sites.

**Tembec** is a major producer in forestry products marketing its products in over 50 countries. By the end of 2003, the company had more than 55 manufacturing units and approximately 10,000 employees, gross sales attaining \$3.3 billion, and assets of nearly \$4.0 billion. Tembec has operations in Québec, Ontario, New Brunswick, Manitoba, Alberta, British Columbia, and in the United States, France and Chile. Total R&D spending was \$111 million, or 3.3% of its revenue, and this put Tembec at the 22<sup>nd</sup> place among Canada's top 100 corporate R&D spenders list of 2003<sup>27</sup>. The Timmins region operations produce 400,000 tonnes of newsprint out of Kapuskasing employing 700 employees. Smooth Rock Falls operations produce 200,000 tonnes of kraft pulp with 325 employees. In late 2000, 16.3 million dollars were spent for facility upgrades-electrostatic precipitators and expansion of effluent treatment facility. In 2002, \$1.5 million was invested in equipment to reduce total reduced sulfur emissions at the mill. But total sulfur emissions are still above government regulations and Tembec plans to invest an additional \$3.95 million to upgrade the facilities.

Tembec has forestry processing facilities with locations in Kapuskasing, Cochrane, Hearst, Timmins, Opisatika, Kirkland Lake. There is an annual processing capacity of 550,000 MFMB and Tembec employs more than 1,000. Infrastructure investments include \$16 million at the Cochrane site in 2002 and \$830,000 is planned for future investments. At the Timmins operation \$8 million was invested in new equipment.

### **Northwestern Ontario**

- Thunder Bay and Northwestern Ontario is one of North America's leading forestry production centres. Forest-based products make up approximately 84% of the total annual value of Thunder Bay's manufacturing output, and are valued at approximately \$2.3 billion per year. An estimated 95% to 97% of the output for the pulp and paper facilities and sawmills are exported. Currently direct and indirect employment from the

---

<sup>27</sup> RESEARCH Infosource

forestry sector accounts for approximately 25% of the total Thunder Bay labour force. It is estimated that every job in the forestry sector creates approximately another 1.2 to 1.4 indirect or induced jobs. This is mainly influenced by the fact that the forestry industry is the city's major purchaser of goods and services such as electrical power and fuels, and machinery and parts.

- Over the last ten years, the major expenses incurred for the industry were maintenance, with most companies investing about \$30 million, with the exception of Bowater which has invested approximately \$750 million in technology and mill improvements.
- Since the Smurfit-Stone mill closure in late 2003, there are now three major pulp and paper companies located in Thunder Bay: **Cascades, Bowater, and Abitibi**. In addition, Bowater also operates a sawmill employing 190 people, but the Thunder Bay market is dominated by the Buchanan Group of Companies who operate four sawmills in the area. They are the seventh largest Canadian softwood lumber producer.
- The forestry industry is cyclical and has declined recently as a result of the high USA exporting duties, lower than usual lumber prices, and the strengthening Canadian dollar. This has caused a number of layoffs across the region. For instance, the Buchanan mills have laid off approximately 1,500 employees; while many of these are temporary, about 800 of these are expected to be permanent. In total, Northwestern Ontario has experienced approximately 3,000-3,500 layoffs that are expected to be permanent from White River to Kenora.

#### **1.3.4 Key Regional Growth Factors**

Within Northern Ontario, economic stability and diversity has been limited. Reliance has been placed on natural resource industries to drive the economy. Unfortunately, over the past year, high tariffs for Canadian softwood imposed by the United States along with a stronger-valued Canadian dollar against the US dollar and an excess of lumber in the market have led to layoffs in the forestry sector across Northern Ontario. Conversely, in the mining sector, Inco is expecting a 7.5% increase in nickel output for 2004 and it is expected that demand will outstrip production for several years to come.

Overall, the key growth factors of the Northern Ontario economy are dependent upon the factors influencing the natural resources industries. The mid to long-term, trends within these sectors are difficult to predict.

## 1.4 Education and Skills Profile

There are several universities and colleges located in Northern Ontario. In addition, the Northern Ontario Medical School (NOMS) is currently being developed with campuses to be located at both Lakehead and Laurentian Universities. Information on each University is provided in section 3.1 and enrolment statistics for some, in addition to provincial totals, are shown in Appendix 3. The Colleges are profiled in section 3.2 and are organized by region. The overall skills and education levels across the region are provided in section 3.3. The vast majority of the information contained herein has been derived from the Regional Innovation Profiles that were generated from each region (Appendix 8).

### 1.4.1 Universities

#### **Algoma University College**

**Enrolment:** Algoma University College (AUC) is an affiliate college of Laurentian University and has over 25 degree programs offered in humanities, social sciences, natural sciences, and professional areas. In 2003 there were 950 students enrolled.

**Graduates:** AUC offers several science programs and is looking to complete its existing 2 and 3 year programs with the introduction of complete four year degree programs. Program options include arts, mathematics, finance and sciences.

#### **Lakehead University**

**Enrolment:** Enrolment and graduate levels at Lakehead University have been consistent with trends across Ontario from year to year and fairly consistent over the past decade (see Appendix 3). Lakehead University is a relatively small university and had an undergraduate enrolment of 4919 in 2003<sup>28</sup>. Lakehead University has accounted for approximately 2.7% of Ontario's total enrolment from 1994 to 1999. Lakehead offers a range of undergraduate programs in the arts, humanities, science (applied bio-molecular science, environmental science, chemistry, biology, etc) business, engineering and health (nursing, kinesiology, social work, etc), among others.

**Graduates:** There were approximately 246 agriculture and biology graduates from Lakehead University in 2002. More specifically, 65 graduate degrees (Bachelors and Masters) were forestry-related. Lakehead also offers graduate programs in Business, Kinesiology, Nursing, Forestry and the Environment, Biology, Chemistry, Public Health, Engineering and others. Furthermore, Lakehead is in the late stages of the development of a PhD program in Forestry. Relative to the Ontario average, other major universities boast a significantly higher graduate level and, therefore, provide a greater human resource pool to biotechnology firms. The University has indicated a willingness to develop a curriculum to meet the needs of industry, including the needs of the biotechnology sector.

---

<sup>28</sup> [www.lakeheadu.ca](http://www.lakeheadu.ca)

### **Lake Superior State University (LSSU)**

**Enrolment:** Located in Sault Ste. Marie, Michigan (USA), Lake Superior State University (LSSU) is located across the International Bridge from Sault Ste. Marie, Ontario. Total undergraduate enrolment at LSSU is 3,077. Of the student body at LSSU, 18% are Ontario residents. LSSU offers programs in business, computers, engineering and science.

### **Laurentian**

**Enrolment:** Total undergraduate enrolment has become relatively stable since 1998 with an approximate enrolment of 6,000 students in 2002, which represents about 3% of Ontario's total enrolment. There is a range of undergraduate programs to choose from at Laurentian University. Laurentian offers degrees in the humanities, arts, science, health and engineering, to name a few. Laurentian University also offers professional programs such as commerce and administration, midwifery, education, e-business science, social work, nursing, and others.

**Graduates:** Total graduate enrolment has followed the increasing trend for Ontario university enrolments between 1995 and 1999. Laurentian University offers a number of master's level programs such as engineering, sciences, human development, physics, and geology. The University is exploring the development of several Ph.D. programs. Some of the areas for expansion include: earth sciences, Biomolecular Sciences (to be started in September 2004 with the new Chair in Cancer Research in partnership with the Northeastern Ontario Regional Cancer Centre and the Sudbury Regional Hospital), Boreal Ecology, Mining Engineering, Health, and Applied Human Sciences.

Laurentian University is also partnered with Science North to offer a one-year graduate diploma in Science Communication. As a team, Laurentian University and Science North will bring together interdisciplinary theory, practical experience and knowledge that meet the tests of academic credibility and down to earth relevance. The first course will begin on August 3<sup>rd</sup> of 2004 and the program will run through June 2005.

### **Nipissing University**

**Enrolment:** Nipissing University is an undergraduate institution with a Faculty of Arts and Science and a Faculty of Education (focus on teacher education). Science-related departments include: Biology, Computer Science; Geography; Liberal Science program; Mathematics, and Psychology. The university does not currently offer professional engineering. Nipissing University is in a rapid growth phase and has just begun a Strategic Planning process that will be completed in January 2005. Enrolment in 2003 was 5,849 – a 70% increase over 1999 and slightly less than 3% of Ontario's total.

**Graduates:** The University is newer (established in 1992) and maintains a relatively fresh faculty. Research is being actively supported through internal grants, reduced teaching loads, and the establishment of research institutes. It is anticipated that in certain areas, including Biological Sciences, a Masters degree program will be developed within the next four years. The presence of on-site graduate students will increase the research agenda. The Sciences have been designated as an area in the university where strategic investments will be made to support research. In 2002, a new academic, \$11.2 million dollar expansion was completed at the university from Superbuild funds. The majority of this building is devoted to scientific programs. Teaching and research labs were constructed and scientific equipment purchased. In



addition, technicians and new tenure-track appointments in the sciences have recently been made, with several more slated for 2004. Currently the University is searching for tenure-track positions in Analytical Chemistry and Molecular Plant Biology.

### **Northern Ontario Medical School**

The inaugural class of the Northern Ontario Medical School (NOMS) will commence in September 2005. The School is a collaboration between Laurentian University in Sudbury and Lakehead University in Thunder Bay. Currently, school officials are planning the curriculum for the four year program. NOMS will enroll 56 students per year, with 24 based in Thunder Bay and 32 in Sudbury.<sup>29</sup>

At the time of this report, it is thought that research conducted at NOMS will be broad and will include biomedical, clinical, public health, population health, epidemiological, psychological and social sciences and health services research.<sup>30</sup> The specific research initiatives will depend on the faculty hired. NOMS is currently filling twenty full-time faculty positions, including 14 basic and six human scientists. Of this, half will be located in each of Thunder Bay and Sudbury. Each of the scientists will perform research in approximately 2/3 of his or her time. The scientists will utilize approximately 10,000 square feet of wet and dry research space, housed within the NOMS buildings at Lakehead and Laurentian Universities.

An Associate Dean of Research will commence effective April 1, 2004 and the first mandate will be to develop a Strategic Research Plan, with an anticipated completion date of September 2004.<sup>31</sup>

## **1.4.2 Colleges**

There are several colleges located throughout Northern Ontario which are briefly profiled for each region. Additional statistics, where available, are provided in Appendix 4.

### **North Bay/Nipissing/Muskoka**

**Canadore College** is co-located with Nipissing University in North Bay. The academic focus is: Information and Communication Technology; Aviation; Hospitality and Tourism; and Health and Community Services. Canadore also has a strong Aboriginal Learning Unit. Enrolment in 2003 was 4,500. Canadore offers a nationally recognized *Biotechnology Program* consisting of two years at the college followed by a year of field placement. This program, which utilizes state-of-the-art teaching technology, offers direct entry into industry. Employment in this field covers all sectors of the industry including research and development, clinical trials, manufacturing, quality control, and federal regulation.

Biotechnology at Canadore is an integrative technology with several scientific disciplines. These disciplines include cell biology, chemistry, physics, molecular biology, genetics, biochemistry, microbiology, immunology, fermentation and bioinformatics. The

---

<sup>29</sup> [www.normed.ca](http://www.normed.ca)

<sup>30</sup> Dr. Roger Strausser, Dean of NOMS, August 2003 ([www.normed.ca](http://www.normed.ca))

<sup>31</sup> Dr. David Boyle, Executive Director of Project Development, Northern Ontario Medical School

professors in this program have expertise that includes medical technology, genomics, molecular cytogenetics and bioinformatics.

**Georgian College** is a medium-sized college located in Barrie but with a small campus in Bracebridge. The programs offered by Georgian cover a wide range of interests. Two areas of particular interest are the automotive service and hospitality/tourism industries.

**Collège Boréal's** main campus is in Sudbury. However, the campus in Sturgeon Falls covers the Nipissing area and recently agreements have been reached with Canadore College to offer certain programs in North Bay. While the Nipissing campus offers a wide range of programs, the Echo Centre of Excellence focuses on French-language training.

**The Canadian Career College**, located in North Bay offers an extensive number of courses directly related to business.

### ***Regions of Sudbury/Manitoulin/Parry Sound***

**Cambrian College** provides students with a variety of courses in applied arts and technology. It teaches theory combined with hands-on experience. A proposed new degree in Biotechnology is to be offered in partnership with the Northern Centre for Biotechnology and Clinical Research (NEUREKA!!) and would further develop educational and applied research opportunities. Out of the 1,898 Cambrian graduates in 2002, over 60% of the students graduated from a program in science and technology.

**Collège Boréal** teaches programs in French though students are also prepared to work in English. College Boreal offers about 50 programs. The total enrolment in 2001 and 2002 was 1024 and 1002 respectively. The majority of students were enrolled in Health Services programs which graduated 128 and 148 in the 2001 and 2002, respectively (the total number of graduates was 397 and 418 in 2001 and 2002, respectively). The College focuses on advanced technology and innovation, and is a leader in integrating notebook computers and using video conferencing methods.

Features of the main campus in Sudbury include a resource centre, high-technology laboratories, model classrooms, learning support services, a well-equipped sports centre, and a day-care centre. It also promotes access to computer networks with more than 2,300 connections. It has specialized laboratories for different areas of study. Examples include chemistry, computer science, dental, early childhood education, greenhouse, medical radiation, mining and urban construction engineering, natural environment science, pharmacy technician, and welding and fitting.

College Boreal offers apprenticeship programs in various fields. At the Sudbury campus, 'Analyse de soutien informatique' is offered. Other than this, there are also the 'Educatrice/Educateur de la petite enfance', 'Aide enseignant – Aide enseignante', and 'Prepose, preposee aux pieces' programs. College Boreal has been engaged in an international exchange program for 5 years.

### **Sault Ste. Marie/Algoma**

**Sault College of Applied Arts and Technology (Sault College)** reported an enrolment of 2,135 in 2003 which represents just less than 2% of the total college enrolment throughout Ontario. The college offers programs in applied arts, business, health and technology. Sault College has the following collaborative programs:

- Collaborative Bachelor of Science - Nursing program;
- International University/College Division Criminal Justice, Computer Studies and Teacher Education;
- Sault College/Algoma University Program Articulations

### **Thunder Bay/Northwestern Ontario**

**Confederation College** hosts a full complement of science and technology programs. The forestry and environmental technology programs provide graduates for biotechnology applications focusing on forestry and bioproducts. There are approximately 3,200 full time students at the college.

### **Timmins/Cochrane/Temiskaming**

**Northern College** maintains 3 campuses in the Timmins, Cochrane and Temiskaming areas. The Kirkland Lake Campus, the Timmins/Porcupine Campus, and the Haileybury Campus. The Haileybury Campus is located near Lake Temiskaming in New Liskeard. Despite its small enrolment size, it is world-renowned for its Haileybury School of Mines (HSM). Another popular program offered is the 2-year Veterinary Technician Program.

Haileybury School of Mines (HSM) started with part-time mining classes in 1912. There are over 2000 graduates pursuing careers in mining and mining-related fields throughout North America and around the world. It has also provided expertise to schools of mines in Zimbabwe and Chile, and has taken the lead on numerous international mining education and training projects.

The programs with the most enrolments are: Social Service Worker, Personal Support Worker, Police Foundation, Community Gerontology, and Nursing, which lie within the Human & Health Services and Social Services areas. Enrolment seems to shift in both directions from year-to-year; but enrolment in Human & Health Services programs appears to be increasing. Overall, enrolment number has not changed significantly in the 10-year period between 1993 and 2003. The total enrolment in 2003 was 1,701 (preliminary) and 1,688 in 2002.

According to responses from a recent survey, the Northern College of Applied Arts & Technology had a total number of 737 graduates in 2002. The largest number of graduates was from the Human & Health Services. Computer science was another area with increased enrolment.

The following apprenticeship programs are offered at Northern College: Aboriginal Early Childhood Education, Construction & Maintenance Electrician, Educational Assistant Apprenticeship Program, and Welder Apprenticeship. The Province of Ontario pays for approximately 83.5% of the tuition for technical apprenticeship training. There is also a Collaborative Nursing Program offered by Northern College in partnership with Laurentian University.

**Collège Boréal**, which is based out of Sudbury, has 7 campuses of which 4 are within the Timmins area. These are the Hearst, the Kapuskasing, the Timmins, and the New Liskeard campuses. The Kapuskasing Campus merged with Hearst in order to offer a range of services for the forestry industry in Northern Ontario. One of the most prestigious projects is the CEFNO (Centre of Excellence for Forestry in Northern Ontario). It encompasses all training aspects of the forestry industry from R&D to practical hands-on training in related occupations.

Most of the enrolments are for the Natural/Physical Sciences & Technology and the Health Services programs. The Natural Sciences programs focus mainly on forestry. In 2001 and 2002, there were 269 and 233 students enrolled at the Timmins campuses.

In 2001, there were 137 graduates and 72 of them graduated from the Natural/Physical Sciences & Technology study area. This study area includes programs such as veterinary, fishing and wildlife management, motor mechanics, and industrial maintenance techniques. In 2002, there were 116 graduates in total and 41 of them were from the Natural/Physical Sciences & Technology area, and 42 were from the Business and Administration Studies area.

**Hearst University College** is one of Laurentian University's affiliated university colleges and includes 3 campuses located in Hearst, Kapuskasing, and Timmins. The College offers various programs including Administration of the Businesses, French, Geography, Management, History, Psychology, and Sociology. All students enrolled at the Timmins location are part-time. This campus does not offer any Science or Biotechnology related programs, nor Computer Science or Engineering programs. All enrolments were under the study areas of 'Other' and a small number under 'Business'. There were 69 enrolled students in 2002<sup>32</sup>.

## 1.5 Skills and Education Profile of the NOBI Region

Detailed information was obtained for Thunder Bay and Northwestern Ontario; these findings may be broadly applicable to the overall trends across Northern Ontario. In Thunder Bay, the total number of individuals working in the natural and applied sciences is 1,955, with a further 740 employees working in technical occupations relating to natural and applied sciences. The number of employees in the technical job fields compares favourably, on a percentage basis, with other select Ontario communities. Unfortunately, Thunder Bay does lag behind the provincial averages for individuals working in applied sciences fields. Northwestern Ontario's education level is lower than the provincial averages. In the District of Thunder Bay, 12.7% hold a university degree while 14.1% hold a trade certificate. In the Districts of Rainy River and Kenora, 9.0% hold a university degree while 13.6% hold a trade certificate. In the community of Thunder Bay, 34% of the citizens hold a university or non-university certificate, while 18% hold at least a university degree. Thunder Bay has a slightly lower level of university graduates relative to the Canadian average and other biotechnology communities, but a higher level of college graduates and certificate holders.

From the respondents to a survey sent to 17 major employers and biotechnology firms in Thunder Bay, there are a minimum of 80 employees with PhDs in science (of which, a significant number have molecular biology or biochemistry backgrounds), 90 with

---

<sup>32</sup> Hearst University College

master's in science or forestry, 167 with undergraduates in science or forestry, 16 with MBAs and 108 engineers. Data for four other major organizations was also retrieved using other methods and included in the count. Nonetheless, all employees with these educational backgrounds have not been accounted for.

Other communities of Northern Ontario have also compiled information regarding number of highly qualified individuals. In Greater Sudbury, there were approximately 500 Ph.D.'s who were employed in 2002: 455 working full-time, and 40 part-time. The Sudbury region also contains 1210 Master's degree holders who work full-time and an additional 155 who work part-time<sup>33</sup>. In the city of Timmins, there were approximately 15 Ph.D.'s and 240 Master's degree holders who were employed full-time, and 20 Master's degree holders who were employed part time in 2000. In Haileybury, 100 Master's degree holders worked full-time, and 10 worked part-time in 2000. The Sault Ste, Marie and Algoma region employs 190 Ph.Ds, 40-50 are employed at the Canadian Forest Service, 17 with the Ontario Ministry of Natural resources the remaining are primarily employed at local universities and colleges (90 at Lake Superior State University).

---

<sup>33</sup> Statistics Canada 2001 Census of Canada

## 1.6 Research & Development Profile

There are numerous research and development activities ongoing in Northern Ontario. These are typically undertaken by the University, government, not-for-profit and private sectors. Research programs ongoing within the University sector are described in section 4.1. The research activities of the other sectors have been grouped according to subject area. The majority of the identified research in Northern Ontario can be encompassed within the following three categories: Health (section 4.2), Forestry/Agriculture/Environment (section 4.3) and Mining (section 4.4).

### 1.6.1 University Research Initiatives

Research Infosource Inc. publishes an annual ranking of the Top 50 research universities in Canada. In 2002, the University of Toronto topped the list with \$456 million in research funds<sup>34</sup>. Two Universities in Northern Ontario were included in this ranking. Laurentian University was ranked 30th with almost \$15 million and Lakehead University was at 34th, with almost \$10 million.

#### **Lakehead University**

In its 2002-2003 Annual Report, **Lakehead University's** research and equipment funding amounted to \$9.3 million. This is an increase of more than 100% since 1998. Of this total, \$5.0 million was received from federal government agencies, \$2.7 million from provincial government agencies, \$1.3 million from private organizations, and \$200,000 from other organizations or persons.

Lakehead University has capacity for 7 Canada Research Chairs, currently, these include:

- Michael Bedard, Dept. of Psychology - Aging and Health
- Lionel Catalan, Dept. of Chemical Engineering - Industrial Waste Management and Site Remediation
- Gary Genosko, Dept. of Sociology - Technoculture Studies
- Ellie Prepas, Faculty of Forestry and the Forest Environment - Sustainable Water Management and the Boreal Forest
- Heidi Schraft, Dept. of Biology - Molecular Food Microbiology
- Open - Aboriginal Studies
- Open – Science

Some of the research initiatives at Lakehead University include:

**The Centre for Northern Forest Ecosystem Research (CNFER)** which is located on Lakehead University's campus. This is an applied research unit of the Ontario Ministry of Natural Resources (OMNR) with a focus on the effects of forestry practices on boreal ecosystems. This includes impacts on soils and forest stand ecology, fish and wildlife habitat at multiple scales, and tourism and recreational values. Research Scientists at CNFER are also appointed as adjunct faculty members in Biology and Forestry and supervise Lakehead graduate students. CNFER has developed strong linkages with

---

<sup>34</sup> [www.researchinfosource.com](http://www.researchinfosource.com)

public interest groups, academic and industrial partners and other governmental organizations in support of collaborative efforts to address new issues and priorities in resource management.

**The Forest Soils Lab** performs tests of chemical and forest soils as well as vegetation samples. These services are used mainly by land managers interested in the impact of their soils on harvesting and site preparation. The two major pieces of equipment that this laboratory uses include the 2003 model LECO CNS-2000 and an AutoAnalyzer II for TOC/TSN.

**The Legacy Forest** is an experimental forestry research initiative with the long-term purpose of studying the impacts of intensive forest management on the values and multiple goals associated with sustainable forest management. The main goal is to answer the following questions:

1. What are the corresponding relationships between intensive silvicultural treatments and site biodiversity, forest ecosystem function, and non-timber values?
2. What are the corresponding trends in landscape level biodiversity, forest ecosystem function and non-timber values at the landscape level as forest management intensity changes?

The Legacy Forest itself will be a framework for research projects that will work towards answering these questions. The main areas of study will be recreation and tourism, socio-economics, wood supply and quality, the aquatic environment, and the terrestrial environment.

**Lakehead University Centre for the Application of Resource Information Systems (LU-CARIS)** provides accurate, timely and cost efficient data and analysis with up-to-date GIS remote sensing and GPS technologies, focused on natural resources and land use management. LU-CARIS also provides GIS modeling and remote sensing with a focus on industrial solutions.

**Lakehead University Geographical Information Systems Laboratory**, located in the new ATAC building, the Geographical Information Systems Laboratory provides access to specialized computer hardware and software to facilitate research in spatially-oriented disciplines.

**Lakehead University Environmental Laboratory** focuses its research on chemical analysis of soils, foliage, water and wastewaters. It also provides the following services:

- Water/Wastewater/Effluents
- Terrestrial Soils/Foliage/Aquatic sediment
- Pulp and Paper Process Chemistry Testing
- Plant Toxicology
- Plant re-establishments in remediated wetlands
- Time of travel and dispersion studies

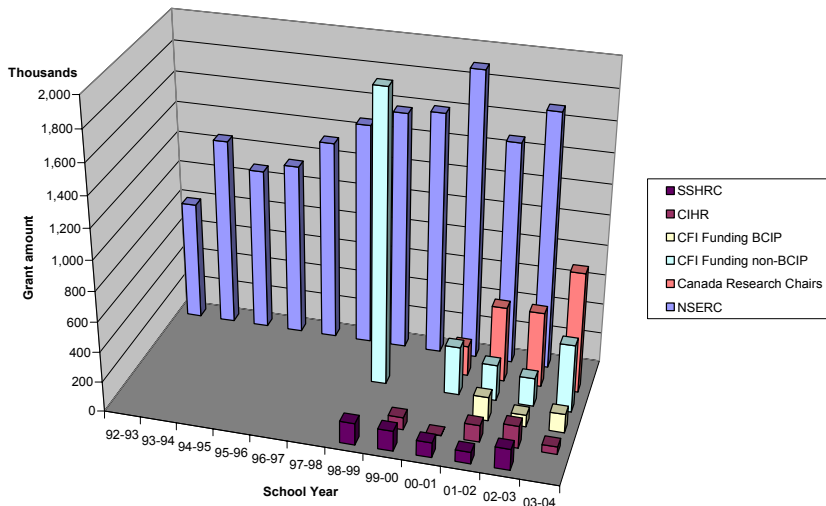
**Paleo-DNA Laboratory**

One of the top ancient DNA research laboratories in the world, the Laboratory has worked with the United Nations to genetically identify war crime victims of East Timor. There are many research projects involving the identification of disease, sex, species and population and migrations studies of animal and human remains. These projects cover the DNA analysis of skeletal remains from Egypt, the Nubian peoples of Kerma, the Chinese of Anyang, the peoples of Central America and molecular studies of mummified remains from all over the world.

Based upon the scientific expertise of the Lab's senior researchers, commercial services including forensic identification, paternity/genetic heritage testing, biodiversity studies and clinical testing are offered through the Laboratory. These funds are used to support the facility and to provide opportunities for faculty and students to conduct their research. Moreover, the Laboratory's services provide students with a chance to gain valuable practical experience in their chosen field of study.

**Laurentian University**

Laurentian University has grown into Northeastern Ontario's comprehensive, bilingual university. University faculties are conducting fundamental research in a broad range of disciplines and will continue to do so in the future. The location of Laurentian University within the Sudbury basin, a unique geological environment, and arguably the mining capital of North America, provides several strategic advantages in exploiting fundamental and applied research problems in certain fields of engineering, as well as in the social, natural and health sciences.

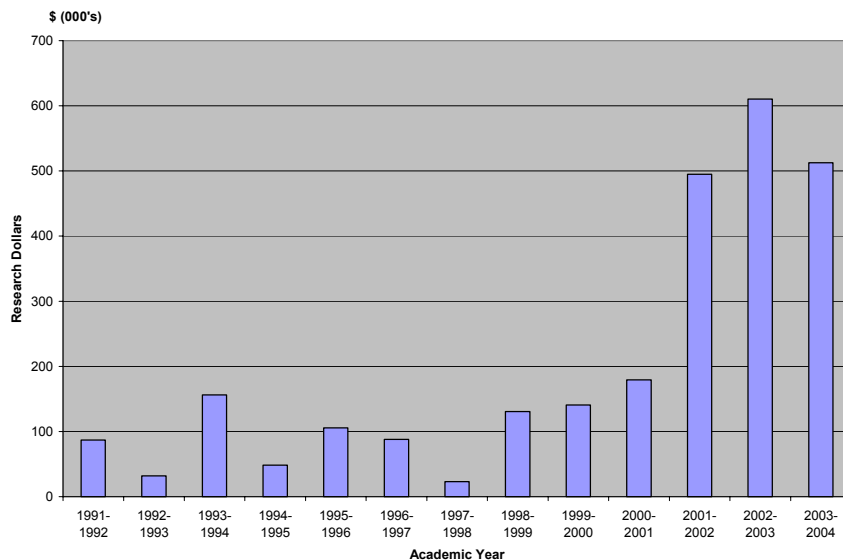


**Figure 5:** Funding trend for research at Laurentian University from major federal funding sources.

Laurentian obtained most of its federal funding from NSERC but very little from the CIHR. This situation is expected to change with the beginning of operation of the new Northern Ontario Medical School. Detailed information on the two major provincial funding sources - the Ontario Innovation Trust (OIT) and the Ontario Research and Development



Challenge Fund (ORDCF) - are not available, but we can assume that about \$1.5 million of the CFI funding will be matched by OIT.



**Figure 6:**  
**Biotechnology-**  
**related research**  
**funding at**  
**Laurentian**  
**University.**

Source: Laurentian University

It is encouraging that the biotechnology related grants have increased significantly in recent years. For example, ORDCF has committed to a maximum of \$1.6 million<sup>35</sup> to a biotechnology-related project at Laurentian. In total, Laurentian experienced a significant 22.7% increase in sponsor-supported research income between FY2001 and FY2002, with a total sponsored research income of \$14,437,000 in FY2002<sup>36</sup>. The university did not provide information on the number of citations.

Laurentian University has capacity for 9 Canada Research Chairs, currently, these include:

- Gunn, John, Dept. of Biology - Fish ecology, stressed aquatic systems
- Anand, Madhur, Dept. of Biology - Biocomplexity of the environment
- Baiden, Greg, School of Engineering - Robotics, teleremote mining
- Arteca, Gustavo, Dept. of Chemistry and Biochemistry - Biomolecular modeling, molecular structures and dynamics
- Kumar, Aseem, Dept. of Chemistry and Biochemistry - Molecular biology, microbiology, septic shock

Other Chair Positions include the NSERC Industrial Research Chair:

- Leshner, Michael C. Dept. of Earth Sciences – Mineral Exploration Research

Ontario Research and Development Challenge Fund Chairs:

- Paul Dunn, School of Engineering [www.mirarco.org/aboutcmt.php](http://www.mirarco.org/aboutcmt.php)
- Spiers, Graeme, Dept. of Chemistry and Biochemistry, Dept. of Earth Sciences, CEM - Environmental monitoring, environmental chemical analysis  
[www.mirarco.org/aboutcem.php](http://www.mirarco.org/aboutcem.php)

<sup>35</sup> Innovation Institute of Ontario

<sup>36</sup> Research Infosource Inc.

- Parissenti, Amadeo, Chair in Cancer Research -Northeastern Ontario Regional Cancer Centre, Dept. of Chemistry and Biochemistry

Other:

- Kaiser, Peter , Chair in Rock Mechanics and Ground Control. Founder of the Geomechanics Research Centre and President and Founder of MIRARCO  
[www.mirarco.org](http://www.mirarco.org)

Laurentian has 51 research contracts for 2003. For the year ended April 30, 2003, the university has \$7.1 million worth of research contracts. Industrial collaborations include INCO, Falconbridge, Cogema, Hunter Dickinson, Farallon Resources, Gagnon Industries, Denison Mines, Rio Algom, and Hatch Engineering.

### ***Nipissing University***

Nipissing University houses a well-established research centre (Nipissing University Environmental Research Centre – NERC) with researchers in biology, chemistry and geography. Recently, the University nominated an outstanding candidate for a Canada Research Chair (CRC) in the area of Biogeochemistry (under the small university competition) to complement the research of this group.

Nipissing University has also made an application to the CFI program for a DNA microarray reader. Although this application was not funded, it is evidence of the growing commitment of Nipissing University to expanding its research capacity. The application process identified several significant collaborative opportunities in genomics and bioinformatics between Nipissing University, the new North Bay Regional Health Centre<sup>37</sup> (under construction) and the Northern Ontario Medical School. Dr. Tony Parkes (Nipissing University) is pursuing several areas of interest, which include:

- A project with the Canadian Space Agency to establish a lab at Nipissing University as a base in North America for in-flight simulation for insect experimentation.
- Free Radical Theory of Ageing
- Metal Contamination and Gene Expression in *Perca Flavesciens* (fish)

### ***Northern Ontario Medical School***

The Northern Ontario Medical School (NOMS) will bring clinical research capacity to the area with a focus on rural healthcare delivery. In addition, there may be an opportunity to develop clinical and teaching models relevant to rural communities based upon telehealth and other models of long-distance service provision.

#### ***1.6.2 Health Research Initiatives***

**The Centre for Rural and Northern Health Research (CRaNHR)** is an interdisciplinary research centre with faculty investigators, affiliated investigators and research staff from various disciplines: administration, economics, epidemiology, geography, gerontology, kinesiology, medicine, nursing, social work and sociology. Most studies are conducted

---

<sup>37</sup> The North Bay Regional Health Centre is a \$225 million project. It is expected that biomedical research will be conducted at the Centre and that the close proximity of the university and the hospital will facilitate collaborative research.

by interdisciplinary research teams. The Centre is an important research asset because rural health is a complex matter that involves many players, interfaces with diverse policies, interacts with many socioeconomic forces.

**Genesis Genomics (Thunder Bay)**

Located in Thunder Bay, Genesis Genomics is a privately held biotechnology company developing a database of mitochondrial DNA (mtDNA) mutations associated with cancer staging and disease inception. Scientists from Genesis Genomics and the Paleo-DNA Laboratory (Lakehead University) with collaborations world wide have been doing mtDNA work associated with disease for over a decade and have already established Thunder Bay as a centre for mitochondrial research. Currently, Genesis Genomics is in the processing of developing a test kit for the early detection of prostate cancer.

Genesis Genomics maintains the goal of establishing a world class research facility in mitochondrial medicine within a 5 to 10 year period through collaborative partnerships with a variety of stakeholders, including government, companies and teaching and research institutions. Genesis Genomics has recently acquired a state-of-the-art laser capture microdissection instrument in addition to its access to real-time PCR capacity and other DNA-based infrastructure. Ongoing and planned partnerships include interaction with Cormac industries to provide bioinformatics software development and support. Hardware support initiatives can be developed with Wardrop, a leading Canadian engineering firm. Other partnerships include Lakehead University, Molecular World, the Paleo-DNA laboratory, and the regenerative medicine research institute and tissue bank, among others.

**Group Health Centre (Sault Ste. Marie)**, the Group Health Centre (GHC) has been conducting clinical trials since 1980. With the implementation of a comprehensive Electronic Medical Record (EMR) in 1997, its research program has expanded to include outcomes evaluation and chronic disease management. Established programs include: diabetes, congestive heart failure discharge transition, anticoagulation clinic, mammography, and immunization, while smoking cessation, vascular intervention, falls and fractures/osteoporosis, and cervical screening programs are currently being implemented. The EMR database is the backbone for the Centre's dynamic, evidence-based medical research in primary care. As a result, GHC has the largest primary care disease site registry in Canada consisting of 58,000 patients. The EMR provides a continuous record of health information from primary care providers, specialists, allied health professionals, hospital, laboratory and diagnostics. Recently, the GHC collaborated with McMaster University on the COMPETE study as well as with CRaNHR in Sudbury on a recent Telehealth study. Over the last 10 years the Centre has allocated \$3,000,000 to \$4,000,000 for research.

**Molecular World (Thunder Bay)**

Located in Thunder Bay, Molecular World offers a full range of DNA services on both current and ancient DNA samples. Services include: paternity testing, forensic DNA testing, DNA sample banking, Forensics and genealogical testing, among others. Molecular World uses state-of-the-art DNA testing equipment including GeneAmp thermocyclers and an ABI Avant genetic analyzer. The facility is equipped with contamination control adhering to industry standards.

**Northeastern Ontario Regional Cancer Centre (NEORCC) (Sudbury)** has integrated with its host the L'Hôpital Regional de Sudbury Regional. Apart from being a health

care delivery organization, NEORCC is actively involved in experimental cancer research. Its activities include clinical trials of radiotherapy and chemotherapy; peripheral stem cell research; immunology, molecular biology, epidemiology, psychosocial and behavioral research; radiation, physics and dosimetry research; and image registration research.

- The Tumour Biology Research Group at the Northeastern Ontario Regional Cancer Centre was founded in 1996 in order to provide a critical mass of researchers in molecular and cellular biology for "translation" of basic research into clinical practice. Since the establishment of the group, the four tumour biology researchers have garnered significant national peer recognition by being awarded a number of research grants from Canada's peer-reviewed research agencies.
- The Epidemiology Research Unit conducts studies that determine and compare cancer incidence and mortality rates and identifies risk factors for various cancers in the northeastern Ontario and specialized occupational populations. Other areas of research interest include studies related to cancer screening, program evaluation, and cancer survival.
- The Clinical Research team conducts clinical trials from phase I to III in the areas of breast, lung, prostate, colorectal, gastric, head and neck cancers as well as acute and chronic leukemias, melanoma and sarcoma. Other areas of study include symptom control trials, which concentrate on improving the side effects of the treatment. Some of the major cooperative groups the team is affiliated with are the National Cancer Institute of Canada Clinical Trials Group (NCIC CTG), Radiation Therapy Oncology Group (RTOG) and the Ontario Clinical Oncology Group (OCOG). This team also collaborates on numerous pharmaceutical company studies.
- The Department of Medical Physics has been devoting efforts to more effectively utilize digital images in routine radiation treatment. The scope of this activity has encompassed i) the production of undistorted digital simulator images, ii) the reliability of subjective evaluation of on-line electronic portal images, iii) the generation of CT images at megavoltage energies, and iv) the automatic registration of prescription and treatment images to verify patient position.

NEORCC has industrial collaborations valued at \$103,536 with Aventis Pharmaceuticals, \$631,131 with INCO, and \$21,520 with Falconbridge. The Tumour Biology Research Group secured provisional patent protection for an agent which can kill breast tumour cells that are highly resistant to two of the most important classes of drugs. If this agent proves effective in preclinical studies, this could provide an effective treatment for recurrent breast cancer. The Tumour Biology Research Group also patented a method for deciding the order of drug administration in clinical trials based on the capacity of drugs to induce resistance to each other. The Group also established a panel of isogenic drug-resistant breast tumour cells lines, for which a number of researchers and private companies have requested access.

The NEORCC has the following 2 Canada Research Chairs:

1. Chair in Cancer Research, Dr. Amadeo Parissenti – (research topic: Protein Kinase C and Multi-drug Resistance)
2. Chair in Biomolecular Science (through Laurentian University but affiliated with the Chair in Cancer Research), Dr. Aseem Kumar – (research topic: Sepsis)

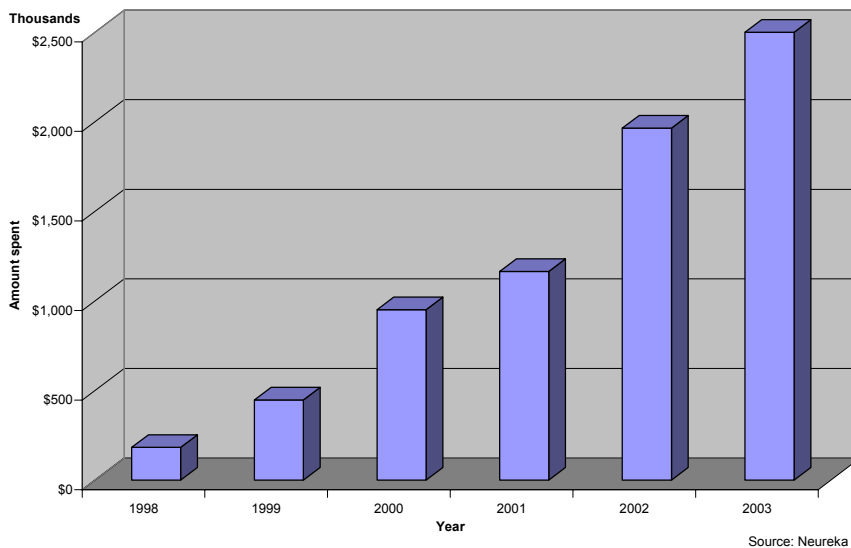
**Northern Centre for Biotechnology and Clinical Research (NEUREKA!) (Sudbury)** was founded in 1996 to diversify Northern Ontario's economy by creating infrastructure to bring Canada's booming biotechnology and clinical research industry to the north. NEUREKA! is committed to providing the Canadian and global markets with novel products and services in the areas of life sciences, especially in health care and biotechnology. Its areas of activities include clinical research, biomedical research and development, and environmental biotechnology. Its two divisions are involved in the following:

Clinical Research Division -- a unique infrastructure with a large network of clinical investigators devoted to providing multifunctional services for pharmaceutical companies and research institutes, allowing for rapid and accurate execution of clinical research. The clinical research studies encompass the following medical specialties: internal medicine, cardiology, respirology, gastroenterology, orthopaedics, oncology, gynecology, infectious disease and psychiatry.

NEUREKA!'s Clinical Research Division has the expertise and resources to perform all aspects of clinical research through a network of professional clinicians and health care organizations. NEUREKA! provides clinical research associates and/or clinical study coordinators for each trial. The Clinical Research Division has the responsibility to assist investigators in the recruitment of patients. As part of the project management services package, staff at NEUREKA! act as a resource for each investigation site and manage all aspects of clinical trials. Its state-of-the-art facilities host clinical trial monitors as well as patient visits.

Biotechnology Division -- partner with universities, research institutes and industry to transfer basic scientific ideas to products and services.

The objective of the Biotechnology Division is to conduct research and develop products in the areas of diagnostics, biopharmaceutical and environmental biotechnology. The budget for biotechnology activity in 2003 was approximately \$2.5 million<sup>38</sup>.



**Figure 7:**  
**Research**  
**spending at**  
**Northern Centre**  
**for Biotechnology**  
**and Clinical**  
**Research.**

<sup>38</sup> NEUREKA!

NEUREKA! has experienced significant growth in research investment since its inception. A recent announcement of an investment of close to \$5 million by the Government of Ontario will expand NEUREKA!'s facilities at Sudbury's Laurentian University campus to accommodate 49 full-time staff, and about \$1.5 million in new high-technology equipment. NEUREKA! has expanded its clinical research into other northern communities by establishing facilities in North Bay, Thunder Bay and Sault Ste. Marie and Timmins.

NEUREKA! had 102 active or pending research contracts for 2002. The total value of research contracts for 2003 is approximately \$1.8 million. The total value generated with industrial pharmaceutical companies for biotechnology projects is approximately \$4.5 million.

#### **Northwestern Ontario Cancer Research Institute (NOWCRI)**

NWOCRI is a partnership of Lakehead University, the Thunder Bay Regional Health Sciences Centre that hosts Northwestern Regional Cancer Care and the Northern Ontario Medical School to develop this research institute. The Institute has been approved by Lakehead University. The overall goals of the program are to increase the number of researchers in Northwestern Ontario and to establish collaborations nationally and internationally. Some of the goals of this important research initiative include:

- Establishing a critical mass of investigators in the region
- Assisting in the development of research infrastructure in Northern Ontario
- Recruiting qualified researchers and healthcare providers to Northern Ontario
- Strengthening the technical capacities of Lakehead University
- Attracting biotechnology and pharmaceutical initiatives

#### **The Paleo-DNA Laboratory (Thunder Bay)**

This is a state-of-the-art facility providing molecular and genetic testing services to the public and companies world-wide. The lab provides DNA sequencing, fragment analysis service and real-time PCR to researchers. In addition, it offers genetic testing including forensic analysis, paternity testing, genetic heritage testing and other custom testing. Its focus, however, is on highly degraded ancient DNA and mitochondrial DNA services. It is believed that the Paleo-DNA Laboratory is one of the top three in the world in terms of its mitochondrial DNA analysis and work on highly degraded ancient samples.

It is estimated that the services currently provided make up only 10% of the total facility's capacity. Relative to other universities, Lakehead University's facility provides the similar basic molecular and genetic testing services. In addition, no other Canadian university provides DNA services on ancient biological samples. It globally ranks among the top five facilities within its class, is a result of the facility's design, personnel training and expertise, as well as the quality controls in place to prevent contamination and to ensure sample integrity. Currently, it is seeking accreditation by the Standards Council of Canada and ISO 17025 to offer forensic services to RCMP and OPP. If successful, it will be the first university laboratory in Canada to receive this accreditation.

#### **Regenerative Medicine Research Institute and Tissue Bank Initiative (Thunder Bay)**

The Northwestern Ontario Technology Centre is coordinating a project to establish a not-for-profit organization in Thunder Bay that will procure and store cadaveric tissue and will undertake biomedical research to expand the therapeutic applications of cord blood

stem cells for tissue regeneration. The development of the Regenerative Medicine Research Institute and Tissue Bank is moving forward and the organization is expected to incorporate in 2004. The vision of the research arm of the organization is to generate knowledge in the rapidly expanding field of regenerative medicine with the goal of developing novel cellular therapies for the repair of damaged tissues.

**Northgate Medical Clinic (North Bay)**

The Northgate Medical Clinic was established in 1997 with 4 Family Physicians, an Internal Medicine Specialist, a Clinical Trials Coordinator and a Laboratory Technician serving approximately 10,000 patients. Services offered include primary care as well as follow-up care in Cardiorespiratory, Endocrine, Gastroenterology, Rheumatology and Respiratory. The Northgate Medical Research Team has participated in many Phase III and several Phase IV Trials.

**ProBity Medical Research (North Bay)**

Dr. Rosoph heads ProBity Medical Research, with extensive work in Dermatology clinical trials, therapeutic research in Dermatology and Clinical Research on new developmental drugs. Presently, ProBity Medical Research is involved in Phase II to Phase IV testing in Biological and Clinical Research.

**North Bay Research (North Bay)**

North Bay Research, run by Urologist Dr. Bernard Goldfarb, has been involved in Pharmaceutical Research since 1997 with trials ranging from Phase II to Phase III. In addition, North Bay Research is involved with medical device trials.

**1.6.3 Forestry/Agriculture/Environment Research Initiatives**

**The Centre of Excellence in Forestry of Northern Ontario (CEFNO)** is an initiative of Collège Boréal at the Hearst and Kapuskasing campuses. At the Kapuskasing campus the centre specializes in forestry operations. The operation encompasses all training aspects of the forestry industry from research and development to practical hands-on training in related occupations. The Hearst campus specializes in the transformation of wood fibre and industrial maintenance. CEFNO's services are bilingual and adaptable to client needs.

The NOHFC and the province have committed \$3.8 million in establishing CEFNO at the college. For instance, in March 2000, the NOHFC announced a contribution of \$288,000 to help CEFNO's campuses in Hearst and Kapuskasing purchase the most modern equipment to help train skilled workers in the latest technologies used in the forestry sector.

**Cooperative Freshwater Ecology Unit (CFEU) (Sudbury)** was formed in 1989 with the Department of Biology of Laurentian University. The CFEU provides research opportunities in the fields of restoration ecology, environmental science, and aquatic resource management, for undergraduate and graduate students, and provides an education program that benefits students, government, and the general public. Current areas of study include climate change, endangered fish species rehabilitation, zooplankton and fish community interactions in acid-stressed lakes.

An important initiative of the CFEU is **The Living with Lakes Centre (Sudbury)** is a co-operative centre that will become an internationally recognized centre for studying the impact of human activities on the lakes streams and wetlands in Northern environments. The centre will provide a critical mass of scientists and infrastructure needed to attract highly qualified personnel to the region. The research, monitoring and science transfer programs of this Co-op involves up to 50 contract staff and students per year and an annual budget of over \$1 million. The Centre will include a new \$800,000 Aquatic Restoration and Ecology Laboratory funded by CFI and OIT.

**The Dorset Research Centre (Environmental Science Centre)** in Muskoka began its scientific activities in 1975. Since then, the centre has grown in size and scope and investigates a wide variety of issues. The Ontario Ministry of Environment and Ministry of Natural Resources are the agencies heading the research at the centre. It should be noted that this centre was recently closed, but there may be a possibility for renewed funding and support in the future.

Research and monitoring activities at the Dorset Research Centre have included:

- the study of acid precipitation;
  - biological monitoring;
  - nutrient enrichment/trophic status relationships;
  - trace metal cycling and toxicity; and
  - climate related global change.
- scientific activities at Dorset include surveillance and policy development as well as applied research and monitoring.

**The Forestry Research Partnership (Mattawa)** based at the Canadian Ecology Centre in Mattawa is partnered with the Ontario Ministry of Natural Resources, Tembec Inc., the Canadian Ecology Centre and the Canadian Forest Service, among others. The research activities of the Partnership are primarily spent on collecting existing information and having it collated and analyzed for local application. The results of this research are applied locally in Northeastern Ontario and have a direct economic impact to Tembec and other forest-related companies. However, few of the research scientists involved are from the North Bay area. Many are located with government agencies, for instance in Sault Ste. Marie or Thunder Bay or at universities such as the University of Guelph.

**Great Lakes Forestry Centre (GLFC) (Sault Ste. Marie)** is one of five Canadian Forestry Services centres located across Canada. Its people fill key Government of Canada roles in research and development program development and delivery, and policy-making at national and international levels. It currently employs 69 researchers and has a total staff of 160 with an additional 60 term and guest workers that are in addition to staff from other departments, academia, not for profit and other organizations. **Over the past ten years it has received \$223 million in research funding and, in combination with OFRI, represents the highest concentration of forestry scientists in Canada.** The centre has received 12 patents in the last 10 years and filed 5-6 invention disclosures. In addition, the GLFC has contributed 650 journal articles, 114 government Information Reports, 158 government technical notes, 94 book chapters and 155 other publications (proceedings, brochures, file reports). The centre is nationally and internationally recognized for its scientific leadership in pest management research. The



centre has identified several areas for strategic growth in the coming years. These include:

**Forest Biotechnology and Bioproducts**

- Identify potential spin-off technologies from its research program for development in the biotechnology industry. Currently, an ongoing partnership includes the Ontario Genomics Institute.

**Climate Change and Other Major Forest Disturbances**

- Contribute to our understanding of carbon budgets, and contribute to national and regional models through quantification of the effects of fire and insects in a changing climate.

**Forest Productivity**

- Collaborate on research that improves the integration of silvicultural systems with wood processing requirements, particularly in an intensive forest management system.
- Collaborate on research that improve growth and yield modeling for commercial tree species and developing a decision support systems sustainable development

**Forest Ecosystem Processes**

- Complete database to support the mapping, conservation policies and succession modeling of forest ecosystems.

**The Great Lakes Laboratory for Fisheries and Aquatic Sciences (GLLFAS)** is a research division of the Central and Arctic Region of DFO, is located at the Canada Centre for Inland Waters (CCIW) in Burlington, Ontario. A satellite GLLFAS group is located at the Sea Lamprey Control Centre in Sault Ste. Marie, Ontario. GLLFAS has approximately 25 staff who conduct freshwater fisheries research in support of DFO priorities related to fish habitat, sea lamprey and the Great Lakes Action Plan, and who provide scientific advice to clients and co-operators.

**Kapusking Beef Cattle Research Farm** is operated by the Dairy and Swine Research and Development Centre of Agriculture and Agri-food Canada. The research farm develops technology to improve the cost-efficiency of beef production in Eastern Canada. Its team conducts research into reproduction, herd management and forage use and conservation. The farm has four barns housing 250 beef cattle, and 370 hectares to produce the forage needed. This research operation has a staff of 12 and a budget of approximately \$1.2 million in 2003.

**LEVTEK** (Thunder Bay) is a laboratory facility, associated with Lakehead University, that provides pulp testing and chemical engineering testing services primarily for pulp and paper mills.

**Mikro-Tek Inc. (Timmins)**

Mikro-Tek is a Canadian biotechnology company that produces strains of naturally occurring mycorrhizal fungi that increase the survival and/or growth of plants and trees. Target markets include forestry, land reclamation and agriculture. Since 1990 Mikro-Tek has invested more than \$12 million in research and development of its products. Mikro-Tek provides fungal concentrates to seedling nurseries nationally and internationally (Chile, South Africa, and Israel). Mikro-Tek possesses laboratory facilities to isolate propagate and mass produce fungal products of commercial value. Currently, Mikro-Tek's most established markets are in Canada and Chile. In both countries, Mikro-Tek can offer its services and products in exchange for the carbon credits applied to the new planted lands.

**New Liskeard Agricultural Research Station (NLARS)** of the University of Guelph operates three stations in Northern Ontario. NLARS manages approximately 680 acres along with an additional 120 rented acres in and near New Liskeard. Research programs focusing on agronomy, beef, horticulture and sheep are all carried out in this central station. There are three main units within NLARS:

Agronomy and Horticulture Units: The Agronomy unit focuses on adapted crop species including spring wheat, barley and oats, canola, and perennial forages such as alfalfa, clovers and grasses. Research areas include cultivar evaluation, crop nutrition and new species evaluation. The Horticultural unit has five 30 by 44 metre ranges dedicated to horticultural research. These research plots are located on a clay loam soil with tile drainage and equipment for both drip and overhead irrigation. Other studies involve the development of techniques to improve the production and/or economic viability of horticultural crops in Northern Ontario.

Seed Potato Upgrading Distribution Unit consists of a tissue culture laboratory, greenhouses and cold storage facilities. It produces 'nuclear' potato plantlets and minitubers for Ontario seed potato producers. Strawberry and Raspberry plantlets are also produced for the Ontario Plant Propagation Program.

Beef Unit consists of 110 brood cows and their calves housed in newly-constructed facilities. This unit, located on approximately 400 acres in Dymond Township, is predominately used for pastures. The Ontario Cattlemen's Association (OCA) has shown its commitment to beef research by assuming ownership of the herd through the purchase of successive calf crops. Also, the beef program is a partner in a major project which is evaluating various factors affecting meat quality, one goal of which is to develop *genetic evaluations for meat tenderness*.

Despite the closure of other research stations in Northern Ontario, the funding to the NLARS is stable at around \$600k for 2003. NLARS does not have any patents and has not licensed out any of its technologies<sup>39</sup>.

**Ontario Forest Research Institute (OFRI) (Sault Ste. Marie)** is the main forest research unit for the Ontario Ministry of Natural Resources (OMNR). OMNR works with a range of partners including Ontario's forest industry and other natural resources clients support for sustainable forest management. OFRI currently employs 12 key researchers. Over the past ten years it has received \$43,000,000 in research funding. The centre has secured 1 patent in the last 10 years and filed 1 invention disclosure.

**Sault Ste. Marie Innovation Centre** is a not-for-profit organization with a mandate to assist Sault Ste. Marie & District with economic diversification in information technology or knowledge-based industries. This centre has received \$30,000 (last 4 years). One focus of the Centre is to promote forestry and other biomass related research, however other projects could also be supported.

**Science Works! (Sault Ste. Marie)**

ScienceWorks will lead local efforts with federal, provincial and municipal governments, private industry, academia and not for profit organizations to establish recognized global

---

<sup>39</sup>NLARS

capacity for the commercialization and application of research and innovation based on natural resource sustainability and life sciences. Its mission is the application of scientific discovery in Sault Ste Marie and the commercialization of opportunities arising from this scientific discovery.

Science Works! is dedicated to developing a globally competitive cluster of international research, education and innovation in natural resource sustainability. The mission is to stimulate knowledge-based economic development through a multifaceted approach including:

- promoting the collaboration of private and public sector institutions;
- developing educational and training resources;
- commercializing new and existing research products and services; and
- capitalizing on its strategic location

The Science Works! initiative is currently under development and a number of studies are ongoing regarding feasibility, concept development and impact analysis. A number of community partners have contributed funding to ScienceWorks!, these include:

- Algoma University College
- City of Sault Ste. Marie
- Canadian Forestry Service
- FedNor
- Group Health Centre
- OMNR-OFRI
- Sault College
- SSM Economic Development Corporation
- SSM Innovation Centre
- SSM Public Utilities Inc.
- St. Mary's Paper

**Upper Lakes Environmental Research Network (ULERN) (Sault Ste. Marie)** is an incorporated not-for-profit organization with charitable status that facilitates and promotes collaborative environmental and natural resources research and development and communication relevant to the Upper Great Lakes Basin.

ULERN is a unique coalition of researchers, resource managers, and educators working in natural resource and environmental fields. Our membership is drawn from federal and provincial levels of government, educational, industrial and not-for-profit sectors and resides throughout the province.

On December 6, 2002, ULERN hosted a workshop and information session on the future of Bio-Products in Northern Ontario. Held at the Great Lakes Forestry Centre in Sault Ste. Marie, participants and presenters included: Canadian Forest Service, OMNR (Ontario Forest Research Institute), Sault Ste. Marie Economic Development Corporation, Ministry of Northern Development and Mines, and Ministry of Economic, Development and Trade. This one-day meeting brought together 75 key players in biotechnology in order to share information and promote networking on the state of bio-product development in the North.

*"ULERN board and staff have revitalized their strategy and positioned the organization to accommodate the growing knowledge economy. ULERN is expanding its environmental focus by looking more broadly at how renewable*

*resources, through the use of enabling IT and biotechnologies in research and development, can provide benefits to other important service sectors, like health, energy, materials and food.”*

Dr. David DeYoe, President, ULERN Board of Directors

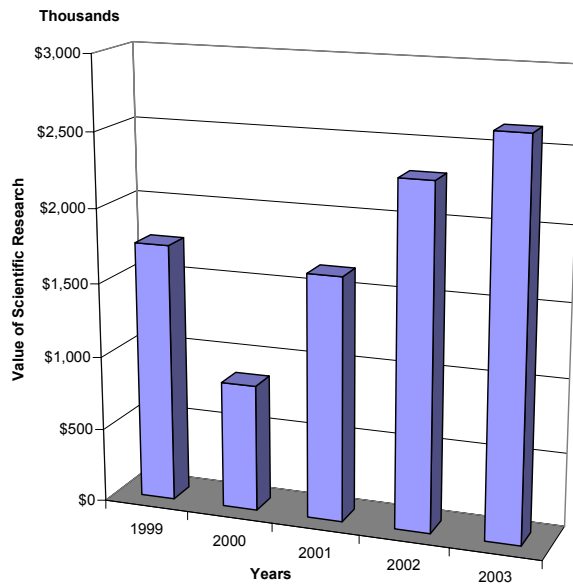
Since its creation in 1997, ULERN has accessed more than \$10 million in research funding, provided 300+ student and intern job opportunities, and hosted 9 workshops and conferences bringing an estimated economic impact of \$4 million to the City of Sault Ste. Marie. ULERN has been described as a “best practice” by decision-makers in Ottawa and has been invited to showcase its operational plan to numerous organizations.

ULERN provided the project management services for the Northern Ontario Biotechnology Initiative (NOBI), the first stage of this pan-northern project.

#### **1.6.4 Mining Research Initiatives**

**The Mining Innovation, Rehabilitation and Applied Research Corporation (MIRARCO) (Sudbury)** was founded in 1998 and is a not-for-profit applied research and technical service company formed through collaboration between Laurentian University and the private and public sectors. It promotes mining innovation and provides a bridge between researchers and industry. It consists of five main research centres or programs:

- Geomechanics Research Centre (GRC) carries out engineering and technical R&D in the geotechnical field and applies its findings to promote safer and more economical mining. GRC is a technical service oriented research group.
- Centre for Environmental Monitoring (CEM) provides innovative applied multidisciplinary research, monitoring and development services to aid resource industries in the solution of problems in ecosystem remediation, rehabilitation and restoration.
- Centre for Mining Technology (CMT) provides applied research and development focused on monitoring and control systems, simulation of operations research, systems engineering and mine equipment and systems automation.
- MIRARCO's Mining Exploratorium Program offers data visualization expertise in CIMTEC's virtual reality laboratory, the only facility worldwide that specializes in mining and exploration. MIRARCO does this through its VR Mining Exploratorium Program.
- Centre for Integrated Monitoring Technology (CIMTEC) is hosted by Laurentian University and managed by MIRARCO. CIMTEC provides technology for the deployment of applied field monitoring, data transfer, processing and visualization. CIMTEC also provides software expertise to assist with analysis and visualization.



**Figure 8: Research funding levels at MIRARCO (1999 – 2003)**

Source: MIRARCO

MIRARCO has research equipment and infrastructure worth over \$6 million. MIRARCO, through Laurentian University, has 3 Canada Research Chairs:

1. Peter K. Kaiser – Chair for Rock Engineering and Ground Control;
2. Graeme Spiers – Chair for Environmental Monitoring
3. Paul Dunn – Chair for Mining Technology.

In the year ended April 30, 2003, MIRARCO had 33 research contracts valued at \$2.635 million. MIRARCO receives between 30 and 50 citations each year from the media and various journals.

### 1.6.5 Other Research Initiatives

**Sudbury Neutrino Observatory (SNO)** is collecting revolutionary data that has provided insight into the properties of neutrinos and the core of the sun. The detector was built 6,800 feet under ground in Inco's Creighton mine near Sudbury, Ontario. SNO is a heavy-water Coherence detector that is designed to detect neutrinos produced by fusion reactions in the sun. It uses 1000 tonnes of heavy water contained in a 12-meter diameter acrylic vessel. Neutrinos react with the heavy water (D<sub>2</sub>O) to produce flashes of light called Coherence radiation. This light is then detected by an array of 9600 photomultiplier tubes mounted on a geodesic support structure surrounding the heavy water vessel.

The Canada Foundation for Innovation announced in December 2003, a \$38.9 million investment towards transforming the existing Sudbury Neutrino Observatory into a lasting world class research facility. FedNor provided support funding for \$595,000. SNO will conduct experiments that build on the success of the original SNO project. This project will bring together a consortium of researchers from six Canadian universities: University of British Columbia, University of Guelph, Laurentian University, Queen's University, and University of Montreal. The administrative centre will be located at Carleton University.

### 1.6.6 Technology Transfer Infrastructure

Technology transfer in Northern Ontario is primarily supported by Lakehead and Laurentian Universities. It should be noted that NEUREKA is also developing capacity in intellectual property management and technology transfer and could be accessed by a variety of regional initiatives. At Laurentian, the technology transfer infrastructure includes the Intellectual Property Management Office (IPMO) that was established in 2002. The office functions in support of university researchers in commercialization of research advances. The office is associated with a consortium of Ontario university technology transfer offices as well as external collaborative partners to offer a full range of technology transfer services. The university does not currently have any patents, and consequently no licensing revenue. However, there have been 5 disclosures of invention in 2003. Laurentian does not currently have an internal research investment fund.

Lakehead University has maintained an Innovation Management Office (IMO) since February 2000. Experience related directly to the life sciences and biotechnology sector has been developing since the Innovation Management Office's inception in 2000. The IMO has been active in providing expertise internally and externally throughout the region. Lakehead University participates in the Association of University Technology Managers (AUTM). This data reveals that Lakehead University has 2 people dedicated to technology transfer. The Technology Transfer Officer is a licensed lawyer in Ontario and performs the licensing duties. The Business Development Officer is a Chartered Accountant and performs business analysis and provides management expertise through the IMO. As of 2002, the IMO has 1 invention disclosure, 2 total patent applications, 1 new patent application and 1 US patent issued. Since then, there has been an exponential increase in invention disclosure and patent applications. Lakehead University also has one biotechnology spin-off company. The data from AUTM indicates that overall, Lakehead's generation of patents and invention disclosures is limited due to the relative size of the University. However, when compared per research dollar, Lakehead University performs well (see below). A secondary resource is the Northwestern Ontario Technology Centre, where management expertise is available.

Institution	Invention Disclosures	Total Patent Applications	New Patent Applications	US Patents Issued
Lakehead University	27	53	27	27
Rest of Ontario	41	20	11	6
Rest of Canada	52	32	23	9
Rest of North America	43	35	21	12

Source: AUTM

Overall, Northern Ontario is well serviced for technology transfer and the commercialization needs of the region are met by the infrastructure provided by the local universities.

## 1.7 Transportation and Technology Infrastructure

Northern Ontario has access to all major transportation systems including air, road, rail and marine.

### **Air**

All of the major communities have access to air transportation through local airports and are serviced by Air Canada and Air Canada Jazz airlines. There are many charters as well as one or two private airlines that travel throughout the region. For instance, Thunder Bay has an International Airport, which is the 3<sup>rd</sup> busiest in the Province of Ontario, handling more departures and arrivals than any other airport except Toronto and Ottawa. North Bay, with its 10,000 foot runway (the longest north of Toronto) can accommodate any size aircraft and has Customs Clearance.

### **Rail**

CNR and CPR's main line from Toronto, Montreal and Western Canada all converge in Sudbury, making Sudbury a main terminus for rail services in Northeastern Ontario. Both CN and CP have major lines into Northwestern Ontario. They collectively provide service to all industrial areas in Canada and are well connected to the USA rail system. Both CN and CP provide inter-modal services which allow its customers to easily transfer their goods from road to rail. These facilities have ample capacity to handle increased traffic. In addition to these national carriers, Northern Ontario is also serviced by the Ontario Northland Transportation Commission (ONTC). Headquartered in North Bay and on the C.N. Rail/CPR Network, ONTC provides a variety of transportation (passenger and cargo) and telecommunications services with approximately 1,060 full-time staff<sup>40</sup>. The ONTC is an Operational Enterprise of the Province of Ontario, and its purpose is to ensure that Northern Ontario's transportation and telecommunications infrastructure is competitive, creating an attractive and modern region where businesses and communities can grow and prosper.

### **Ports**

Thunder Bay and Sault Ste. Marie provide shipping access to the Great Lakes. The strategic locations of these ports allow interchange of cargo moving east/west across Canada as well as north/south across North America. The ports provide marine shipping access to other points on the Great Lakes such as Chicago and Burns Harbour, Indiana, as well as international ports via the Great Lakes/St. Lawrence Seaway system. Operating approximately eight months in a year, the Ports are capable of processing all types of cargo and provides a wide range of services including grain processing, liquid bulk handling, vessel layover, ship repair and Canada Coast Guard search and rescue base.

### **Road**

Northern Ontario is well serviced by networks of highway systems. For instance, Highway 11 intersects with Highway 17, part of the Trans-Canada Highway System in North Bay and transverses Northern Ontario providing a major link to Southern Ontario, and the rest of the country.

---

<sup>40</sup> <http://www.ontc.on.ca/english/index.html>

### **Technology Infrastructure**

The technology infrastructure has improved dramatically over the last few years throughout Northern Ontario. Canada's largest telecommunications companies, such as Bell Canada and Rogers AT&T provide telecommunications services to most areas. In many Northern communities, both broadband and internet services, including dial-up, DSL and cable, are provided or will be established in the short term. In the urban centres internet connections are typically 100% digital.

Current telecommunication providers operating throughout the region include a number of satellite and digital cable providers, Bell Express Vu, Shaw Cable and Star Choice, several high speed and dial-up internet providers, local telephone companies, and several long distance telephone providers.

The major centres in Northern Ontario (North Bay, Sault Ste. Marie, Sudbury, Thunder Bay and Timmins) are part of the Ontario Research and Innovation Optical Network, ORION through the academic and research infrastructure. ORION is a high-speed, optical network that brings affordable, world-class broadband access and connectivity to Ontario's research and educational institutions<sup>41</sup>. The goal of ORION is to foster collaborative research and education in Ontario by offering the most technically advanced, affordable connectivity to universities, colleges and research institutions, no matter where they are located in the province. With access points in 21 major centres, and gateway connections to other research networks such as CANARIE's CA\*net4, Internet2 in the US and the Internet, ORION links Ontario's post-secondary institutions and publicly funded research organizations to one another, the rest of Canada, and the rest of the world. ORION's next generation, all-optical Internet technology provides its users with a significant increase in bandwidth capacity. With optical wavelength capacities at 10 gigabit speed, scalable to 320 gigabytes, ORION opens the door to a vast network of resources and applications and enables the development of next-generation Internet technologies and applications. ORION is owned and operated by the Optical Regional Advanced Network of Ontario (ORANO). A not-for-profit organization, ORANO is governed by a Board of Directors that includes leaders from the fields of education, research and business. The Ontario Ministry of Enterprise, Opportunity and Innovation (currently the Ministry of Economic Development and Trade) and Ontario's SuperBuild Corporation are ORION's primary funding partners. The Government of Canada has also invested funding through CANARIE, Canada's Advanced Internet Development Organization, which operates CA\*net4. ORION's partners also include additional private and public sector organizations and institutions.

---

<sup>41</sup> ORION is not available to the general public



## 1.8 Natural Resources and Specialty Infrastructure

Accounting for almost 90% of Ontario's landmass, Northern Ontario has tremendous access to all natural resources and species living among the natural resources: trees, freshwater including small inland lakes as well as Lake Superior, peat moss, perennial grasses, metals and minerals, wildlife, fish, herbs and other plants. Bioproducts, including non-timber forest products, as well as value-added timber products, created through biotechnology processes, are two areas representing substantial opportunities to the communities in Northern Ontario. As additional research continues in these two areas, sustainable forest and environmental management will continue to be a priority.

### *Harvesting the Forest*

With an area of 49.8 million hectares, **Northwestern Ontario's** Boreal Forest is by far the largest in the province. Black spruce covers the majority of the land, but several other species are abundant in both the hardwood and softwood working groups. Within the forest management planning area of Northwestern Ontario, there are 25.3 million hectares, of which 79.4% is available for harvesting. However, simply because the land is available for harvesting does not mean that the wood will be the right size, type or is in a reasonable location in order to make it cost-beneficial to harvest. A representative of the Ontario Ministry of Natural Resources indicated that there will be a shortfall in the actual available (i.e., cost-beneficial) wood supply, which will not meet the demand of Northwestern Ontario mills by 10% to 15% for the next forty years (see Appendix 5).

In **Northeastern Ontario**, the region is comprised partly by the Central Boreal Forest in the northwest, Claybelt North Forest in the northeast and Great Lakes-St Lawrence forest region in the south. The Claybelt/North Forest and Central Boreal Forest are part of the Boreal forest region. The main differences are the soil conditions and the Central Boreal Forest having a more temperate climate. This allows the Central Boreal Forest to sustain a greater diversity of species than the Claybelt/North Forest. The Central Boreal Forest is characterized as having mixed forest of coniferous trees and hardwood trees where poplar, birch as well as jack pine dominate the landscape. The Claybelt/North forest generally has black spruce fir in the low lying regions of the north and aspen poplar on the highlands in the south. The St. Lawrence is a transition forest of higher concentrations of hardwood red and white pine in the south and more of a Boreal type forest in the north. In the past these forests provided rich resources in the forms of lumber and paper but history of irresponsible harvesting has left stands of lower grade trees. However the past 15 years saw intense efforts in forest replantation and silviculture practices. It is not known whether the current efforts of forest management have curtailed the deficit since estimates of available forest for harvesting are still on the decline<sup>42</sup>.

### *Forest Waste-streams*

Throughout the forestry industry there are various examples of efficient waste utilization. Some examples include many of the pulp and paper mills that now accept wood chip

---

<sup>42</sup> Ministry of Natural Resources

wastes from lumber mills to make paper. Also, the bark removed from wood by pulp mill is utilized as fuel in steam boilers on site and can be used to run turbines for electricity generation. As well, Tembec, in its Quebec plant, is using their wood waste to make industrial grade ethanol. Other initiatives include:

- Northeastern Pressure Treated Wood Inc., Tembec's pulp and paper mills in Spruce Falls and Smooth Rock Falls, Abitibi Consolidated Inc. in Iroquois Falls and Grant Forest Products in Timmins and Englehart all use bark waste to generate steam and energy for their own consumption.
- Three operations transport their wood waste via Weekoban Transport to Hearst Electric Generating Facilities in Calstock. The facilities, owned by TransCanada Power, have a capacity of 35 MW which they generate by burning wood waste and waste heat generated by the local compression station. The consumption of wood generates two thirds of this power capacity and the other third is from waste heat.
- Tembec's Cochrane operation supplies its wood waste to Cochrane Power's Generating Plant which operates on steam driven turbine. Power from the woodburning is rated at 10 MW and the rest of the power is generating from Natural Gas at 32 MW. The plant is operated by Northland Power.
- Another electric cogeneration facility is in Kirkland Lake, which produces 106 kW. It was the first in the world to have a combined-cycle integrated-fuels plant which burns wood and natural gas at the same time. Local mills provide wood waste for electrical energy. The wood ash generated at Cochrane and Kirkland Lake Power Plants are approved and used as a soil amendment product for crops in local fields thereby avoiding the landfill.
- Domtar in White River, has a partnership with private power producer Drayton Valley Power, whereby 450 tonnes of its wood residue are used to operate a 7.5-megawatt power plant.

Overall, forestry waste streams are beginning to become an important source of local energy production.

## 1.9 Regional SWOT Analysis and Conclusions

Strengths	Weaknesses
<ul style="list-style-type: none"> <li>• Northern Ontario is well serviced by industrial transportation infrastructure (highways, rail, port, air)</li> <li>• Northern Ontario offers an availability of developed and undeveloped land for commercial use</li> <li>• Post secondary education facilities provide support and respond to regional and industrial needs</li> <li>• Commercialization support for basic research provided by Lakehead and Laurentian offer adequate technology transfer capacity for the region</li> <li>• The region is able to access several funding mechanisms that would support a variety of initiatives</li> <li>• Northern Ontario is strengthening its basic research capacity.</li> <li>• Northern Ontario contains a vast biomass resource and highly developed forestry industries</li> <li>• World class research capabilities in sustainable natural resources at the federal and provincial laboratories (i.e. the Canadian Forestry Service and the Ontario Ministry of Natural Resources)</li> <li>• Global cluster of mining expertise and infrastructure</li> <li>• Strong network of healthcare providers and professionals</li> <li>• Community support for regional economic initiatives</li> </ul>	<ul style="list-style-type: none"> <li>• The health sector is primarily a service provider, not highly engaged in research and commercialization functions</li> <li>• Industry sponsored research is often undertaken in other regions</li> <li>• Unemployment levels and lower numbers of highly qualified individuals compared to the rest of the province</li> <li>• Limited commercialization and creation of spin-off initiatives compared to Southern Ontario</li> <li>• Limited venture capital investment</li> <li>• Limited spending for basic research</li> <li>• Lack of comprehensive knowledge pertaining to the biomass resources</li> </ul>

Opportunities	Threats
<ul style="list-style-type: none"> <li>• Establishment of a Northern Medical School, bringing teaching and research (clinical) infrastructure to the region</li> <li>• The current shift to a bio-based economy - a focus of the federal government</li> <li>• Compliance with the Kyoto accord to reduce greenhouse gas emissions               <ul style="list-style-type: none"> <li>○ The ability to generate and sell carbon credits within the Kyoto framework</li> </ul> </li> <li>• Paradigm shift to bio-diesel and other green energy sources</li> <li>• Ability to adopt into a technology diffusion, or technology demonstration centre for pilot projects and innovation adaptation</li> <li>• The growing need for bioremediation capacity and innovation</li> <li>• Develop into a region for clinical research development</li> <li>• Establishing ScienceWorks! that will assist in the commercialization of biotechnology in Northern Ontario</li> <li>• Ability to leverage biomass resources and expertise in bioprocessing skills (plant and wood fiber), opportunities include:               <ul style="list-style-type: none"> <li>○ Potential pilot extraction facility</li> <li>○ Establishing a centre for invasive species research and emergency response based in the Sault.</li> <li>○ Establishing a centre of excellence in forestry research and bioproducts.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Competition from exiting and emerging clusters and centres for research dollars and skilled people</li> <li>• Declining biomass resources</li> <li>• Challenges in the export market for natural resource based products               <ul style="list-style-type: none"> <li>○ Strength of the Canadian dollar</li> <li>○ Tariffs</li> <li>○ Fluctuating commodity prices</li> </ul> </li> <li>• Youth out-migration and loss of the most educated/skilled workforce</li> <li>• Aging population</li> </ul>

### **1.9.1 Strengths**

Despite the vast geographic landscape of Northern Ontario the region is well serviced with transportation infrastructure. For instance the trucking industry has always been important to the region, as approximately 40 trucking companies operate out of Thunder Bay. A network of highways connects the various urban centres of Northern Ontario and, importantly, provides links to Southern Ontario, the USA, Western Canada and Quebec. In addition to the strong highway infrastructure, Northern Ontario is well serviced by rail links. Notable, these rail services are extensively utilized by regional industries and support the export markets for forestry and mining products. The bulk transfer of material is also supported by ports located in Thunder Bay and Sault Ste. Marie. In an average year 206,512 tons of wood products, 70,991,151 tons of mineral and 191,511 tons of petroleum products are shipped through the Sault Ste. Marie canal by approximately 8,680 vessels. The region is also well linked by air transportation and each major centre maintains an airport typically serviced by Air Canada and local charter flights. Thunder Bay has the 3<sup>rd</sup> busiest international airport in Ontario.

Northern Ontario boasts several areas of land that are available for commercial development and most urban centres have available commercial infrastructure. This availability, which extends across all centres, is typified by Sault Ste. Marie which reports 2,996 acres of occupied industrial land and 845 acres of vacant industrialized land. Examples of regional incubator parks include the Northwestern Ontario Technology Centre (NOTC) (Thunder Bay), the Northern Centre for Advanced Technology Inc. (NORCAT) (Sudbury) and The Sudbury Centre for Innovation and Technology (SCITech). SCITech offers over 42,000 sq. ft. to high technology companies. The availability of developed and undeveloped lands throughout the region is an obvious asset that could support a variety of initiatives, if required.

Northern Ontario is serviced by three universities and several community colleges. The educational infrastructure of the region has demonstrated a commitment providing expertise for regional industries and applications. For instance, Northern College (Timmins) operates the Haileybury School of Mines which is world-renowned for mining education and training. Other examples would include the numerous programs offering specialized training pertaining to Natural Resources management and the associated industries and manufacturing processes. The regional training and education infrastructure supports regional development and would provide local expertise to support a variety of innovative initiatives.

Lakehead and Laurentian Universities provide technology transfer capabilities that are meeting the current needs of the research and development community. Another positive initiative towards supporting regional innovation is Lakehead's participation in AUTM. This participation indicates a local paradigm shift towards international benchmarking and applying current best practices. Participation in AUTM has revealed that relative to the level of research funding, Lakehead University exhibits an extremely high level of productivity in terms of patent and invention disclosures.

Northern Ontario is in a strong position to obtain financial support for regional initiatives and in particular, SMEs. In this regard, Northern Ontario is able to access several funding mechanisms not available to other regions. Some of these programs include FedNor, the Northern Ontario Heritage Fund, and the Northern Ontario Grow Bonds. Though currently limited, regional venture capital programs and angel investor networks appear to be growing.

The Northern region maintains several research institutes including universities and several not-for-profit organizations. Across the region there has been a trend that indicates an increase in regional research spending. For instance, Lakehead University has increased research funding by 100% since 1998, Similarly, Laurentian's research funding increased 22.7% between 2001 and 2002. In part, this growth has resulted from an increased ability to access funds from federal sources including CFI, CIHR and NSERC. The trend towards higher research support in the region is also evident in the not-for-profit sector as the Northern Centre for Biotechnology and Clinical Research (NEUREKA!) funding has grown from less than \$500,000 (1999) to approximately \$2.5 M (2003), as an example. Although the federal and provincial research laboratories in forestry and natural resources are a significant asset to the region, these laboratories have seen a continuous deterioration of staff, capital, operating and infrastructure over the past ten years. As of yet this trend has not been reversed and must be if these laboratories are to benefit NOBI to their full potential. For instance in bioproducts, a strong interest of both laboratories, there is currently insufficient capacity at the CFS and OMNR to fully contribute to the research and development potential in a bio-based economy. In summary, Northern Ontario is strengthening its basic research capacity.

One of Northern Ontario's greatest strength's is the vast biomass resources. The NOBI region contains approximately 90% of Ontario's land mass and has a highly developed forestry industry. The region boasts a concentration of forestry expertise. Specifically, the region has approximately 4,195 and 18,825 people employed in forestry/logging and wood/pulp manufacturing, respectively. The concentration of forestry expertise is reflected in the location quotients for some these activities (12.25 – logging, 11.22 – sawmills and wood preservation). The industry is dominated by several large firms which include Abitibi, Bowater, Weyerhaeuser, St. Mary's Pulp and Paper and Tembec. The forestry industry commits significant resources to research initiatives. For instance, Tembec spends approximately \$75 M/yr in research and it was also reported (by an undisclosed source) that approximately \$100 M is spent in Northwestern Ontario in forestry related research. Forestry related initiatives include reforestation efforts and research towards generating higher value added products from the forestry biomass.

Northern Ontario is recognized, globally, as a cluster of mining expertise and infrastructure. Regionally, the sector provides 10,715 jobs in mining activities and 7,680 in metal manufacturing. This cluster of expertise is evident from the location quotients of the mining activities (15.44 – metal ore mining, 3.06 – iron and steel mills and ferro-alloy manufacturing). It is estimated that the nickel resources in the Sudbury area will sustain the current level of mining for at least 10-15 years. The key firms in this sector include Inco and Falconbridge which both commit significant resources to research and innovation activities. It is estimated that Inco spends approximately \$17 M (USD) on research annually. In addition to industry, research activities in mining are supported by academia and not-for-profit initiatives. For instance, the Mining Innovation, Rehabilitation and Applied Research Corporation (MIRARCO) is a Sudbury based research initiative. MIRARCO's funding has increased from less than \$1 M (2000) to over \$2.5 M (2003). Overall, the mining sector is a key strength for Northern Ontario, particular when considering the support activities, which range from manufacturing tools and supply items to bioremediation needs.

The provision of health care services across Northern Ontario is a major employment strength that provides 43,330 jobs and has a regional location quotient of 1.38. More specifically, Northern Ontario's hospitals employ 14, 200 people and have a regional

location quotient of 1.53. The health care sector is a major employer of highly trained individuals in Northern Ontario.

The regional economies of Northern Ontario are well supported by a network of local Economic Development Organizations (EDOs). Community support for the economy is provided by the Community Futures Development Corporations, among other initiatives, which provide both business expertise and investment. The high level of community interest and involvement is clearly a strength which Northern Ontario can rely upon to implement regional initiatives.

### **1.9.2 Weaknesses**

While the health sector remains a major employer of highly qualified individuals, there are a limited number of jobs outside of the public service. This reflects a situation whereby the health sector of Northern Ontario is primarily invested in the provision of service and does not broadly include research activities. There are currently no pharmaceutical companies and few healthcare SMEs operating in the region. The limited amount of regional research in healthcare is not generally directed into commercial opportunities. Overall, Northern Ontario engages in very limited technology development and innovation at the local level. This is a key gap that will limit the region's ability to attract local biopharmaceutical partnerships and investment. Currently there is not enough research funding, venture capital and other sources of support to engage in the full range of research, development and commercialization of health research on a nationally or globally competitive manner.

Though research activities are increasing in Northern Ontario, a significant amount of R&D is occurring in regions beyond the NOBI study region. This trend is evident across sectors. For instance, in the forestry sector, Tembec has an extensive research and development program to generate higher valued products from the forest biomass (i.e. phenols, alcohols). However, the majority of this research is undertaken in Quebec and other regions. Similarly, Inco maintains a research centre in Toronto and has several partnership programs with the University of Toronto. Overall, several multinational corporations, that fund research programs, operate in Northern Ontario and a significant amount of their research occurs in other regions.

Northern Ontario typically maintains a higher level of unemployment compared to the other regions of Ontario. In addition, Northern Ontario fails to attract (or retain) qualified individuals in non-resource sectors. The region has lower levels of people with business training such as MBAs compared to the rest of the province.

Northern Ontario has produced few commercial initiatives from basic research activities. For instance, both Lakehead and Laurentian have generated few patents and few spin-off opportunities have resulted from these university. It should be noted that on a per research dollar basis, the commercialization and patenting levels of Lakehead University are relatively strong. However, in absolute terms, this represents a weakness of the region.

Venture capital funding in Northern Ontario is low compared to provincial levels. For instance, the absolute value of venture capital for the region was only \$20 million. Accounting for potential investments that may not have been included in this value, it still

remains a weakness in comparison to the \$10.2 billion recorded for the Province of Ontario. In addition, no investments into biotechnology initiatives were recorded for Northern Ontario.

Research spending in Northern Ontario is increasing, but remains a weakness compared to other centres engaged in research and development activities. For instance, Lakehead and Laurentian Universities each received about \$10 M in research funding for 2003. This level of funding is in contrast to the \$ 456 million received by the University of Toronto. In this light, Northern Ontario lacks a competitive research infrastructure, which encompasses funding levels, equipment, and a critical mass of scientists. This situation, in part, arises from the network of colleges (as opposed to universities) which do not typically undertake extensive research programs.

The forestry industry is a major strength of the region. However, one weakness of this sector is the lack of comprehension and knowledge regarding the value and extent of the biomass resources. In part this arises from a lack of knowledge sharing between major industry players who may protect this information for confidentiality and competitive reasons. Currently, there is minimal data available to quantify biomass resources, such as forest residue, perennial grasses, peat moss and other potential non-timber forest products. In addition, the forestry sector has been weakened with respect to employment opportunities as a result of high tariffs imposed by the United States and the strength of the Canadian dollar.

### **1.9.3 Opportunities**

The establishment of the Northern Medical School (NOMS) represents a significant opportunity for Northern Ontario. This School, with campuses at Laurentian and Lakehead Universities, will bring teaching and research infrastructure to the area. Part of the School's mandate will be research activities pertaining to family and rural healthcare delivery. Overall, NOMS will bring highly qualified personnel to the region and will help to address the gap in training and retaining of medical doctors for Northern Ontario.

The vast biomass resources of Northern Ontario are a growing opportunity as they pertain to the development of sustainable technologies. The management of this valuable resource will become increasingly important with respect to Federal and Provincial government mandates regarding the development of "green" industries and a growing focus on ecologically sustainable development. In addition, the implementation of the Kyoto accord and the utilization of Carbon tax credits will increase the value of Northern Ontario's forestry resources. In addition to the Kyoto accord, rising oil prices and energy distribution costs are making the generation and use of bioenergy an increasingly attractive method of energy generation. As well, bioenergy production has the potential to convert forestry waste streams into revenue streams. The push to develop higher value-added products from the forest presents opportunities for Northern Ontario to further capture the value of its biomass. For instance, the furniture manufacturing activities in Quebec are an example of generating higher value added forestry products. Opportunities exist for the region to locally retain greater value from the forest. As an example, opportunities within the biogases economy could utilize existing technologies to produce bioenergy. Northern Ontario could utilize existing technology platforms for bioenergy production (i.e. Dynamotive and Ensyn) and could



contribute incremental innovation and serve as a demonstration centre for technology implementation.

Current government initiatives to build the biobased economy are a growing opportunity for Northern Ontario. Technologies to better understand the extent of Ontario's biomass resources are in development. An understanding of the depth and sustainability of this resource will be important to developing and sustaining the biobased economy. The broad use of geographic information systems would be a valuable tool in understanding Northern Ontario's resources.

Opportunities also exist within Northern Ontario to build on existing industry strengths (i.e. mining and forestry) to develop improvements in technology that increase efficiency, productivity, profitability, and sustainability. One example of these types of initiatives is the conversion of waste streams into revenue streams to fully utilize harvested biomass. In this manner, one industry's waste (output) can become an important input for another. In this manner, Northern Ontario could function as a technology diffusion centre and act as a receptor for existing technologies on a pilot scale. The region would then add incremental innovation to improve productivity and technology usage. In this regard, it has been recognized that technology commercialization from basic research and discovery activities have been limited across Ontario. Northern Ontario could capitalize on the opportunity to assist in the commercialization process through demonstration facilities or pilot scale facilities, particularly in the area of value-add forestry/bioproducts. Such an initiative would leverage the regional strengths by capturing natural resources, human resources/expertise, and existing industry base.

Federal and Provincial governments are increasingly recognizing the need to increase bioremediation efforts. This applies to both the scope and scale of bioremediation technology platforms. Northern Ontario maintains a need for ongoing bioremediation related to the industrial mining activities. The regional needs for bioremediation present an opportunity to apply and develop methods that improve the efficiency and outcomes of reclamation efforts.

Despite Northern Ontario's limitations in basic research for health applications, there exists an opportunity to leverage the network of regional healthcare providers. Northern Ontario's strengths in clinical services could be applied to clinical research trials for drug development. The distinct populations of Northern Ontario (aging population, First Nations) could provide an important partner in pharmaceutical product development. Existing health services could make the region an attractive receptor for clinical trial capacity and later stage drug validation.

Northern Ontario can be viewed as a cluster of expertise in plant and wood fiber processing. This is evident in the location quotients for pulp and paper mills (10.11) and the existing industrial infrastructure, such as St. Mary's Pulp and Paper, Tembec and others. This processing capacity could be leveraged to generate plant extracts from the extensive, local biomass which could include species of the boreal forest, shrubs, grasses and fungi. Regional species exist that are currently utilized for biomolecules, such as the extraction of taxanes from Yew plants. Additionally, regional capacity exists to grow and produce specialized fungi (Mikro-Tek, Timmins) and the research infrastructure exists at the Great Lakes Forestry Institute (Sault Ste. Marie) could also be applied to such an initiative. Within this opportunity, harvested plant material could be

processed into extracts for distribution to various companies or labs that may be interested in high throughput screening for bioactive compounds.

#### **1.9.4 Threats**

Northern Ontario faces threats from a variety of sources. For instance, other biotechnology clusters and centres can be perceived as a competitive threat as groups compete for research dollars, human capital and industry partnerships.

Declining biomass resources could threaten the sustainability of the forestry sector and the development of a mature biobased economy. For instance, in Northwestern Ontario the available harvest volume is predicted to decline for the next several years (Appendix 5).

Other threats faced by Northern Ontario include the strengthening Canadian dollar which is decreasing export market revenues. Tariffs placed on Canadian lumber continue to threaten the forestry industry and variations in commodity pricing could negatively impact the region's resource based economy. It should be noted that nickel prices are currently extremely strong resulting in Inco maximizing production which is expected to continue throughout 2004. Despite the current favourable conditions for nickel and base mining production, future threats exist. For instance, large recent mineral finds by mining companies outside of the north (Voisey Bay, Newfoundland, Asia) threaten to move both mining and processing capacity out of Northern Ontario. In addition, alternate sites of extraction may provide increasingly cost effective extraction which could impact commodity pricing and increase competition. Competitive challenges related to lower manufacturing costs in other regions extend beyond the mining industry and could threaten the ability to manufacture higher value-add products locally. Examples include labour intensive processes such as furniture manufacturing in Quebec and the establishment of a biomanufacturing cluster in Puerto Rico.

Northern Ontario has been facing a current trend of youth out-migration and an aging population. For instance, in the Algoma district the numbers of individuals aged 15-19, 20-24 and 25-44 years decreased by 5.6%, 18.5 and 16.4% respectively, between 1996 and 2001. This out migration has been coupled with an aging of the population. Specifically, the numbers of individuals aged 75-84 years and 85 and over increased by 17.7 and 22.8%, over the same time period. This has troubling implications for the region as the educated and young in the workforce exit. An additional threat based on the population demographics of Northern Ontario is the limited population base. Northern Ontario comprises only 7.3% of Ontario's population and less than 3% of Canada's. In this regard, Northern Ontario is a small regional market for products and is therefore forced to generate products for export production.

## **2 - The Biotechnology Profile**

## 2.1 Executive Summary

SHI Consulting Inc., on behalf of the Northern Ontario Biotechnology Initiative (NOBI), has undertaken an analysis of Northern Ontario's key strategic assets relating to biotechnology in Step 2: Biotechnology Cluster Strategy of the Biotechnology Cluster Innovation Program (BCIP). By leveraging existing assets to address local and global demands, strategic directions and initiatives have been selected for further development in Step 3 of the Biotechnology Cluster Innovation Program (BCIP). It should be noted that these strategic initiatives, or preliminary business concepts, are likely to change and evolve as the NOBI Steering Committee progresses to the later stages of this project.

Northern Ontario is home to a rich diversity of natural resources which contribute heavily to the export revenues of the province. However, the economy of Northern Ontario is in transition as the focus turns to the export of value-added products and to preparing local companies to compete in the world market. Increasingly, the knowledge-based economy is merging with traditional industries, as successful resource-based industries position themselves for leadership in tomorrow's marketplace. Motivation of industry stakeholders will be a significant issue in this transformation and it is essential that a proactive rather than a reactive approach is taken.

Three major industries in Northern Ontario that have been identified as important by their ability to adopt biotechnology innovations are forestry, healthcare and mining. Each of these industries was analyzed both according to the presence of local receptor capacity (demand), as well as across the four pillars of cluster supply: science and innovation, infrastructure, capital and human resources.

The receptor capacity, or local demand, for innovation in forestry and mining in Northern Ontario is high and these traditional industries have significant assets across all pillars of cluster supply. On the other hand healthcare is primarily a service provision industry in the north, and the local receptor capacity for innovation is somewhat limited. In addition, the assets across the pillars of cluster supply are also limited, but continue to grow. However, the global market opportunity in the health industry is extraordinary and therefore cannot be ignored as an avenue for economic diversification in Northern Ontario.

NOBI has identified three subclusters in which to take a major provincial role: **bioproducts**, **environment** (which includes biomining and bioremediation) and **public health**. Each subcluster provides an opportunity to leverage the existing strengths of Northern Ontario.

In the **bioproducts** subcluster, NOBI has identified the following potential initiatives:

- GIS mapping to determine the quantity, quality and current utilization of forestry resources
- Establishment of commercialization resources for bioproducts
- Chemical and bioactive analysis of plant species of potential high-value bioproduct application

In the **environment** subcluster, NOBI has identified the following potential initiatives:

- Development of a centre of excellence in biomining research and development
- Developing research and demonstration capacity in bioremediation
- Development of partnerships and programs to assist in industrial cooperation towards reducing environmental impact based in the principles of eco-industrial clustering

Within the **public health** subcluster, NOBI has identified the following potential initiatives:

- A centre of excellence to develop robotics for clinical medicine
- A centre of excellence to develop mitochondrial medicine
- Establishment of a tissue and bone bank

NOBI is also interested in playing a minor role in other provincial subclusters, such as medical devices, clinical trials and therapeutics. As well, a key component to Northern Ontario's biotechnology strategy is the development of a Regional Innovation Network (RIN) that could provide a range of services to the local and prospective biotechnology community initiatives (public and private), to promote interactivity between the stakeholders across the vast geographic area, and to network with other provincial and international biotechnology clusters. A key function of this organization would be marketing Northern Ontario's biotechnology sector with the aim to attract new businesses through a cooperative industry marketing strategy. Other functions could include the provision of technology transfer and commercialization expertise to researchers and to small and medium-sized enterprises. Additionally, the centre could undertake public education and outreach, establish a biotechnology job bank, and assume an advocacy and marketing role for investment in Northern Ontario's biotechnology industries.

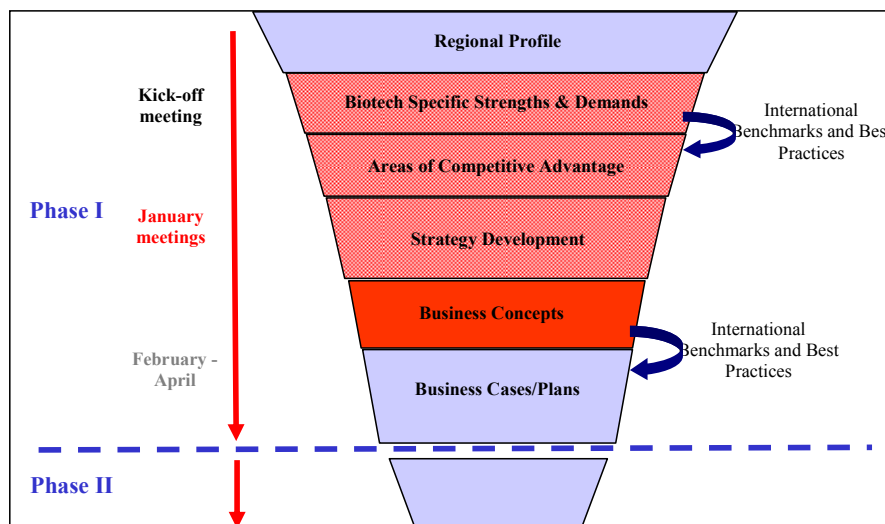
## 2.2 Introduction

### 2.2.1 Objectives

The Biotechnology Strategy announced by the Ontario government on June 7, 2002 intends to make Ontario one of the most competitive jurisdictions in North America for biotechnology. To ensure that this becomes a reality, the government announced a new initiative called the Biotechnology Cluster Innovation Program (BCIP).

The objectives of the BCIP are three-fold: i) To accelerate the development of Ontario's biotechnology clusters by supporting infrastructure projects for commercialization (ranging from physical to soft infrastructure); ii) to focus on creating new research discoveries, new companies and new jobs, revitalizing industries, and supporting skills initiatives; and iii) to support the diffusion of biotechnology-related innovations into knowledge-based and traditional industry sectors.

SHI Consulting Inc. (SHI) was commissioned by the Northern Ontario Biotechnology Initiative (NOBI) to prepare a BCIP submission on NOBI's behalf. This report constitutes Step 2: Biotechnology Cluster Strategy of the BCIP submission. As diagrammed in Figure 1 below, this document moves beyond the Regional Innovation Profile that was completed in Step 1 and begins identifying the key biotechnology-specific strengths, weaknesses, opportunities in relationship to both regional and global demands. From this information, areas of competitive advantage have been identified and developed into a biotechnology strategy. Finally, potential initiatives have been identified for further development in Step 3 of the BCIP.



**Figure 9:**  
**Biotechnology**  
**Cluster**  
**Innovation**  
**Program (BCIP)**  
**Process**

This report outlines the contribution of Northern Ontario towards these ambitious provincial objectives.

### **2.2.2 Geographic Boundaries of the NOBI Region**

The regions represented by the Northern Ontario Biotechnology Initiative (NOBI) consist of five areas of Northern Ontario: North Bay/Nipissing/Muskoka, Sudbury/Manitoulin/Parry Sound, Sault Ste. Marie/Algoma, Timmins/Cochrane/Temiskaming and Thunder Bay/Northwestern Ontario. The geographic area encompassed by the NOBI study area is a vast expanse of approximately 822,000 square kilometres which accounts for nearly 90% of Ontario's total land area. The pan-Northern region borders Manitoba to the west and Quebec and other regions of Ontario to the east. To the south, the NOBI regions border the USA, Lake Superior, Lake Michigan and other regions of Ontario, which include Simcoe and Haliburton counties.

### **2.2.3 Integration of the Cluster within Wider Geographic Scope**

The NOBI envisions significant interaction with the other cluster initiatives across Ontario.

Elements of the Northern Ontario Biotechnology Initiative to potentially leverage with other provincial clusters include:

- Globally recognized forestry industries and forestry-related research centres
- Globally recognized mining and robotics expertise
- Bioremediation, reforestation, industrial product/waste stream optimization
- The development and utilization of biofuels and other initiatives in alignment with the incoming Kyoto accord
- Developing basic research capacity in biomedical research and the introduction of the Northern Ontario Medical School (NOMS)
- Strong network of healthcare provision and clinical trial capacity

### **2.2.4 Description of the NOBI and its Members**

The Northern Ontario Biotechnology Initiative (NOBI) was established as a pan-Northern enterprise with representation from the 5 major urban centres of the region. Appendix 6 provides a complete list of the NOBI Steering Committee. The committee maintains a focus on business and economic development and also includes research directors, scientists, biotechnology entrepreneurs, and academics.

## 2.3 Northern Ontario Biotechnology Cluster Vision and Mission

### 2.3.1 Vision Statement

To ensure that biotechnology is a major contributor to the economic activity of Northern Ontario.

### 2.3.2 Mission Statement

To foster the growth of biotechnology throughout Northern Ontario as a tool to promote economic diversification and public health and well-being. The traditional industries of mining and forestry will be revitalized through the application of biotechnology based innovations. Northern Ontario will also continue to grow and identify areas of competitive advantage in the ever expanding health and biomedical applications of biotechnology. Overall, biotechnology innovation, commercialization and application will be fostered throughout the pan-Northern region and become a greater contributor to the regional and provincial economies.

### 2.3.3 Goals & Objectives

The goals and objectives of the Northern Ontario Biotechnology Initiative are:

To create new employment opportunities within Northern Ontario in biotechnology to both retain local expertise and to attract highly qualified individuals to the region.

To assist the forestry and mining industries in maintaining sustainable and significant revenue growth and maximizing resource utilization by using biotechnology to create higher-value added products.

To apply biotechnology for the improvement of environmental assessment and bioremediation capabilities.

To market and promote the formation and growth of small to medium sized companies focused on the innovative life sciences.

To profit from the emerging biobased economy by positioning Northern Ontario as a global leader in the supply, processing and innovation associated with this market shift.

To become a repository of commercial excellence in specific industry subsectors through the in-licensing of existing technologies.



## 2.4 Description of Cluster’s Biotechnology and Related Assets

### 2.4.1 Industry Profile

Northern Ontario is home to numerous companies that perform activities directly and indirectly related to biotechnology. Three priority industry sectors of regional strength in Northern Ontario include: **forestry**, **mining** and **healthcare**. These sectors have been profiled below as each are capable of incorporating biotechnology innovation.

Potential areas of application of biotechnology within the forestry industry includes bioproducts<sup>43</sup>, bioenergy (bio-oil, biodiesel, biochemicals) and biomaterials. Potential areas of application of biotechnology to the healthcare industry are biomedical R&D and nutraceuticals and functional foods. Potential areas of application of biotechnology to the mining industry are biomining, bioenergy, and bioremediation. These examples of receptor capacity for biotechnology innovation in forestry, mining and healthcare are diagrammed below.

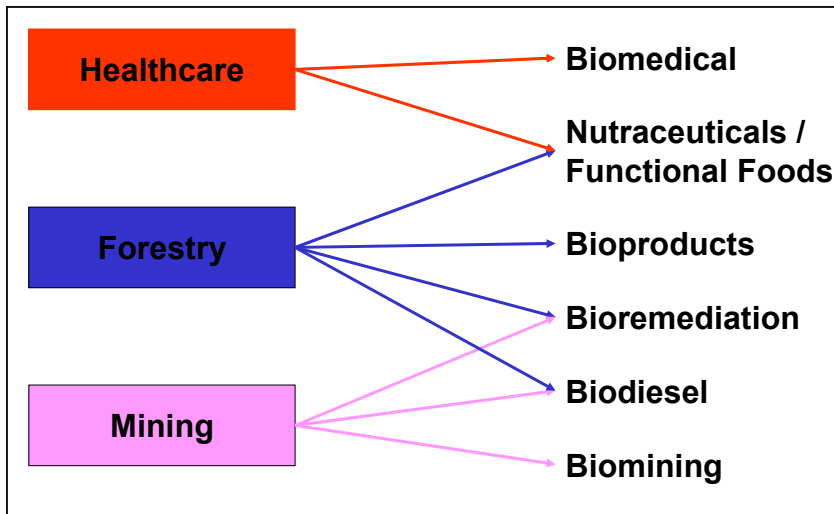


Figure 10: Examples of receptor capacity for biotechnology innovation in Northern Ontario’s major industries

The following table lists the number of companies operating in Northern Ontario within a variety of industries and sectors. For comparative purposes, the total number of companies present in Ontario is also included.

**Table 9: Northern Ontario companies from various sectors relevant to**

43 According to Statistics Canada a bioproduct is defined as “a commercial or industrial product (other than food and feed) made with biological or renewable domestic agricultural (plant, animal, marine or forestry materials, such as bio-energy (heating and electricity), bio-fuels (ethanol and biodiesel), biochemicals, fiberboard, textiles and bio-plastic, other”.

<b>biotechnology compared to provincial statistics</b>		
<b>Sector</b>	<b>Number of Establishments</b>	
	<b>Northern Ontario</b>	<b>Ontario</b>
Total	23,959	346,719
Forestry	900	1,279
Mining	50	341
Building Materials	159	2,478
Food Manufacturing	70	2,073
Beverage Manufacturing	17	263
Plastics Manufacturing	11	1,048
Pharmaceutical and Medicine Manufacturing	2	146
Chemical Manufacturing (excluding Pharmaceutical and Medicine)	26	814
Motor Vehicle Parts Manufacturing	13	648
Measuring, Medical and Controlling Devices Manufacturing	13	375
Information and Communications Technology	307	15858

Source: MEDT, based on Statistics Canada data

The companies operating in Northern Ontario encompass a range of industry sectors that could support an increased shift towards biotechnology. Notably, over 70% of Ontario's forestry companies are operating in Northern Ontario. Significant numbers of companies are also active in the sectors of building materials, food and chemical manufacturing and information technologies. Interestingly, mining companies in Northern Ontario compose less than 15% of Ontario's total. However, it should be noted that Table 9 reflects only the number, not the scope or scale of the companies. It must be considered that over 90% of metal ore mining jobs are located in Northern Ontario (Table 11). In this regard, it is evident that the mining companies present in Northern Ontario, though few, are extremely large organizations.

The strength of the forestry sector in Northern Ontario is evident from the employment statistics which indicate that over 70% of Ontario's forestry employees (NAICS classifications 1133 and 1153) are located within the NOBI region (Table 10). As stated, over 90% of the jobs in metal ore mining activities are located in Northern Ontario (Table 11) and this strength is reflected in the extremely high location quotient (15.44). In addition to the jobs in mining and ore extraction, Northern Ontario boasts a high level of support jobs for the mining sector, which includes heavy machinery repair and peripheral engineering services, among others.

The manufacturing infrastructure and jobs in Northern Ontario primarily support the established forestry and mining industries. A major manufacturing strength of the region is in forestry biomass processing. For instance, employment in sawmills and wood preservation, pulp paper and paperboard mills, veneer plywood and engineered wood product manufacturing provides 18,425 jobs to the region and this strength is reflected in the high location quotients of 11.22, 10.11 and 8.90, respectively (Table 12).

**Table 10: Forestry related jobs and location quotients for Northern Ontario**

<b>Sectors (NAICS classification)</b>	<b># employed in Ontario</b>	<b>Jobs in Northern Ontario</b>	<b>Location Quotient (LQ) - Jobs in Northern Ontario</b>
1133 Logging	3,785	2,730	12.25
1153 Support activities for forestry	1,915	1,325	11.75
1142 Hunting and trapping	180	60	5.66
1132 Forest nurseries and gathering of forest products	255	75	5.00
1141 Fishing	605	55	1.54

**Table 11: Mining related jobs and location quotients for Northern Ontario**

<b>Sectors (NAICS classification)</b>	<b># employed in Ontario</b>	<b>Jobs in Northern Ontario</b>	<b>Location Quotient (LQ) - Jobs in Northern Ontario</b>
2122 Metal ore mining	9,795	8,905	15.44
2199 Mining – unspecified	445	285	10.88
2131 Support activities for mining and oil and gas extraction	2,300	1,105	8.16
2123 Non-metallic mineral mining and quarrying	5,160	420	1.38

**Table 12: Manufacturing related jobs and location quotients for Northern Ontario**

<b>Sectors (NAICS classification)</b>	<b># employed in Ontario</b>	<b>Jobs in Northern Ontario</b>	<b>Location Quotient (LQ) - Jobs in Northern Ontario</b>
3211 Sawmills and wood preservation	9,010	5,950	11.22
3221 Pulp paper and paperboard mills	15,575	9,265	10.11
3212 Veneer plywood and engineered wood product manufacturing	6,125	3,210	8.90
3314 Non-ferrous metal (except aluminum) production and processing	4,015	1,505	6.37
3311 Iron and steel mills and ferro-alloy manufacturing	22,030	3,965	3.06
3331 Agricultural construction and mining machinery manufacturing	7,385	1,070	2.46
3132 Fabric mills	3,420	240	1.19

It is evident that the natural resources industries dominate the landscape of Northern Ontario, but there are also significant biohealth related assets throughout the region. Several key sectors of the biomedical industry are listed in Table 13. Within this industry, Northern Ontario has several sectors with location quotients (LQ) greater than 1, indicating a high share of local employment and suggesting a competitive advantage. These include out-patient care centres (LQ 2.18), other ambulatory health care services (LQ 1.98) and individual and family services (LQ 1.96), among others. It is also noted that hospitals are a major employer throughout the region and provide 14,200 jobs (LQ 1.53).

**Table 13:** Biomedical related jobs and location quotients for Northern Ontario

<b>Sectors (NAICS classification)</b>	<b># employed in Ontario</b>	<b>Jobs in Northern Ontario</b>	<b>Location Quotient (LQ) - Jobs in Northern Ontario</b>
6214 Out-patient care centres	19,315	2,475	2.18
6219 Other ambulatory health care services	5,570	650	1.98
6241 Individual and family services	32,765	3,775	1.96
6243 Vocational rehabilitation services	7,145	730	1.74
6216 Home health care services	14,685	1,390	1.61
6220 Hospitals (6221 to 6223)	157,500	14,200	1.53
6230 Nursing and residential care facilities (6231 to 6239)	87,150	7,345	1.43
6242 Community food and housing, emergency, relief services	2,505	195	1.32
6213 Offices of other health practitioners	25,625	1,565	1.04
6211 Offices of physicians	42,455	2,580	1.03

Some the highest average wages (\$23.08/hr in 2002) across the region were in the biomedical sector (health and education). This exceeds the wages observed in the manufacturing and construction (\$19.35/hr) and the agriculture and other resource based industries (\$16.01/hr). The biomedical industry is a key employer of highly trained and educated individuals in Northern Ontario.

In summary, Northern Ontario is home to several biotechnology related employment opportunities in both the traditional, resource based industries and in the biohealth sector. These assets provide a foundation of regional expertise that can be leveraged towards the continued growth of biotechnology in Northern Ontario.

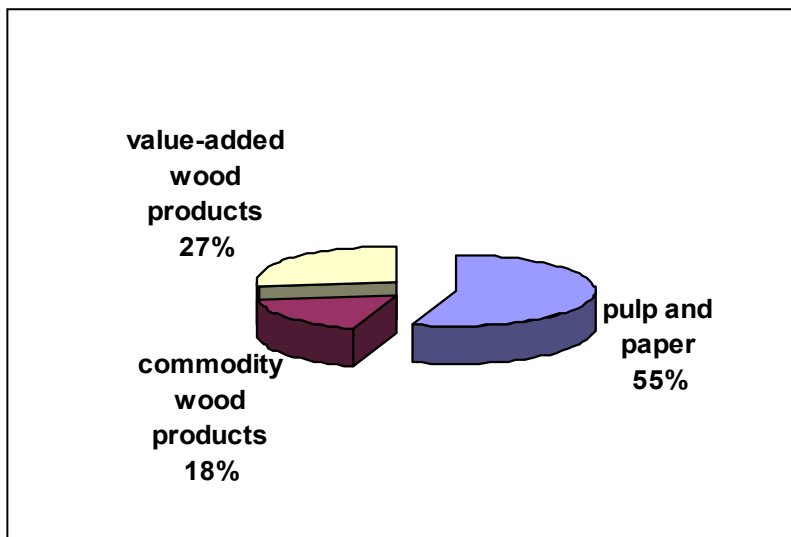
### **2.4.2 Industry Receptor Capacity**

The local receptor capacity is defined two-fold. Firstly, the absolute amount of industry that is located within the region, and secondly, the willingness of these companies to accept innovation, and in particular biotechnology innovation. The challenge is to identify companies receptive to new technologies and to find ways to link these

companies to the technologies of interest. A key need is to both retain industry within the local area and attract new companies to Northern Ontario.

### **The Forestry Industry**

The forestry industry is a major source of revenue, jobs and wealth creation for Ontario. In 1997 the value of forestry products manufactured in Ontario was over \$15 billion<sup>44</sup>. Pulp and paper, which includes commodity (i.e. pulp, newsprint) and value-added (i.e. tissue, corrugated cardboard, fine paper) grades accounted for 55% of revenues, whereas the remaining 45% was in wood-based products (Figure 11). Commodity wood products include lumber, veneer and particle board, whereas value-added wood products would be items such as cabinets, doors and other factory built housing supplies. It should be noted that the growth in value added wood products has been strong in Southern Ontario, yet weaker in the North.



**Figure 11: Ontario forestry products, breakdown of shipment values**

Ontario's forests make up 17% of Canada's forests and approximately 2% of the world's forests<sup>45</sup>. This is the foundation for Ontario's extensive forestry industry. Ontario ranks third in Canada in terms of softwood lumber production and contributes about 10% of Canada's total output. Ontario has increased its share of Canada's export value in the last decade from 13.8% in 1992 to 16.1% in 2002. This is a sign of increasing competitiveness relative to the other provinces. The majority of Ontario's wood product exports are shipped to Michigan and other states surrounding the Great Lakes (Figure 12).

<sup>44</sup> Ontario's Living Legacy Trust, volume 2, original data: Jaako Poyry "Assessment of the Status and Future Opportunities of Ontario's Solid Wood Value-Added Sector. Research Report (26 June 2001) and other volumes.

<sup>45</sup> "The heart of North America's Forest Industry" [www.2ontario.com/industry/forestry.asp](http://www.2ontario.com/industry/forestry.asp)

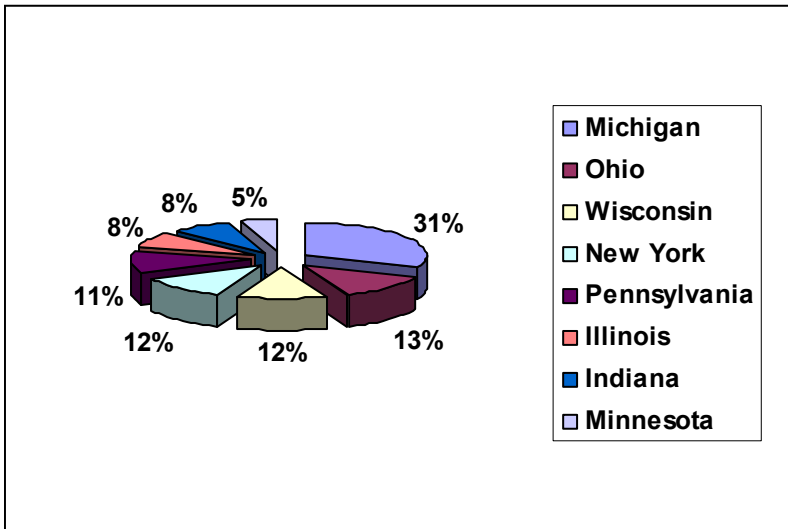


Figure 12: Export destinations for Ontario's wood products<sup>46</sup>

Despite the gains in Ontario's competitiveness, relative to the other regions within Canada, the forestry industry is currently experiencing several challenges that can be attributed to the cyclical nature of the resource industry - notably, American trade tariffs and the strength of the Canadian dollar. The following figure illustrates the downward trend in export revenues. The projected target for 2003 of \$2.3 billion is the lowest level since 1997 and represents a 19% drop from the previous year.

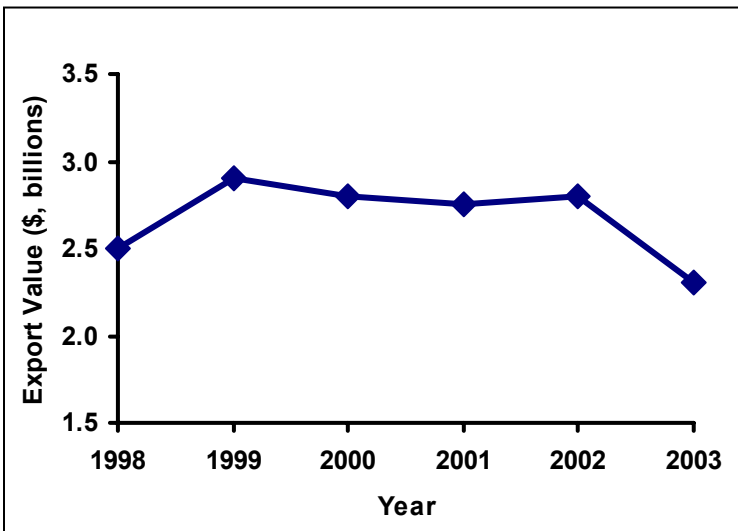


Figure 13: Export value of Ontario's

The forestry industry in Ontario is dominated by a small number of large firms. For instance, 4 firms accounted for over 75% of Ontario's lumber output<sup>47</sup>. Ontario's output

<sup>46</sup> Ontario's Living Legacy Trust, volume 2

<sup>47</sup> *Ibid*

can be broken as follows: Buchanan (37%), Domtar (19%), Tembec (13%) and Weyerhaeuser (7%).

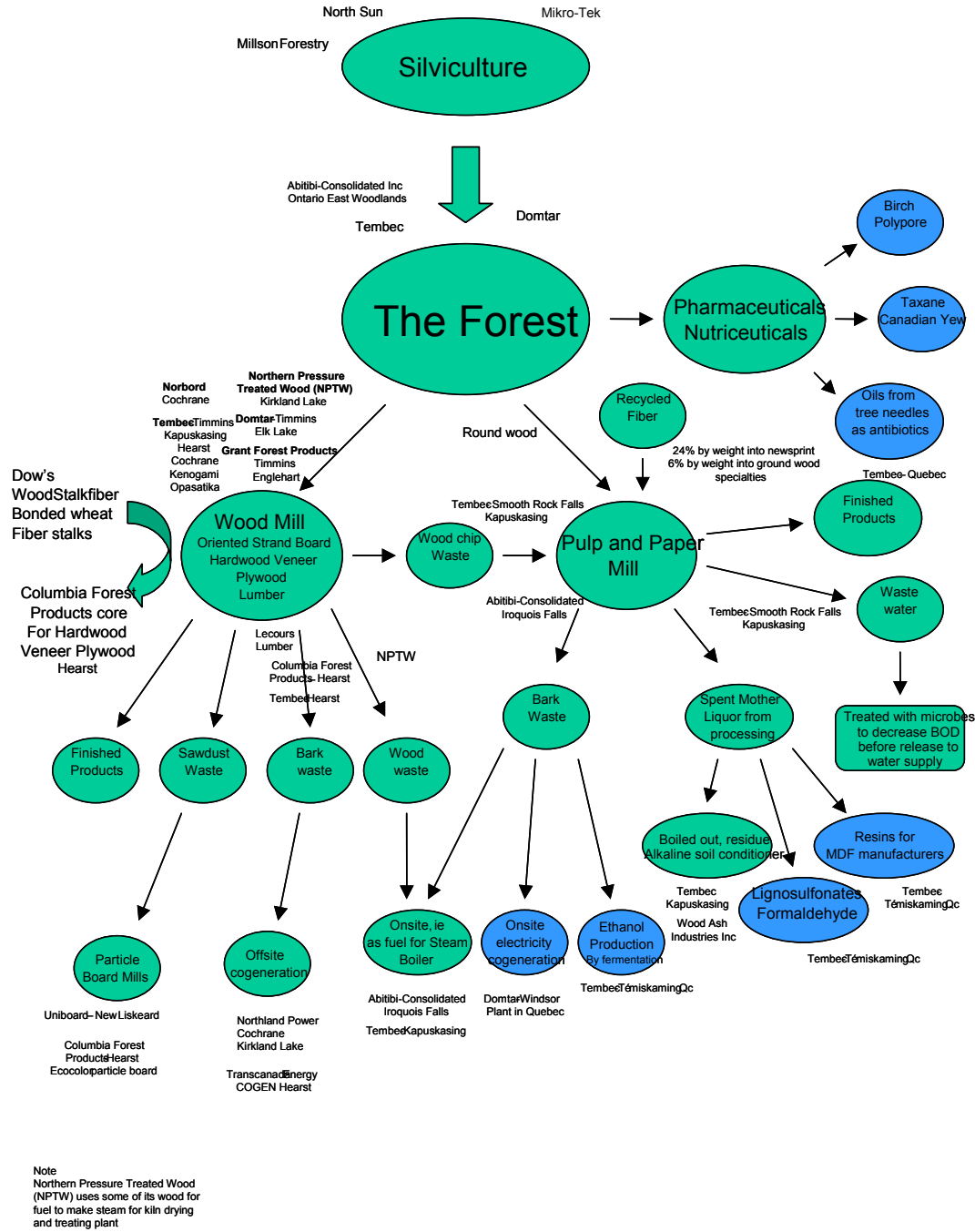
The forestry sector encompasses a vast range of biotechnology activities, as outlined in the figure below which highlights many of the industries that have developed surrounding the forestry biomass. For instance, the forestry industry is a major receptor of products developed for the biological control of pests. In a typical year, at least \$190 million is spent in Canada on forestry pest control<sup>48</sup>. These markets include insect control, disease control, weed control and the control of mammals and birds. Other commercial markets related to the forestry sector include the production of non-timber forestry products. For instance, the total Canadian market size for forest-related foods is \$1.8 billion. Examples include honey, maple syrup, blueberries, and wild mushrooms. In addition, the forest is an important source of health related products. For instance, 477 of the 7,000 species in the Ontario Plant list have known medicinal effects. The growing consumer acceptance of natural health products and functional foods has evolved into a global market with an estimated value between \$70 billion and US\$250 billion, rising 11% annually.

The forest is also an important source of pharmaceutical compounds which are used in the global market for pharmaceutical products, currently estimated at US \$401 billion<sup>49</sup>. Of this, plant derived drugs were estimated to be worth over \$40 billion worldwide in 1995. As there is a movement towards the production of higher value-added products from forestry resources (e.g. identifying important plant species and identifying potential therapeutic compounds from the regional biomass). The production of pharmaceuticals represents an opportunity for Northern Ontario to enter this growing market opportunity. For instance, taxanes are currently harvested from Yew trees that grow in Northern Ontario.

---

<sup>48</sup> The importance of bioproducts to Canada's forestry sector: new partnerships in a knowledge economy, Forest Bioproducts-Duchesne

<sup>49</sup> *Ibid*



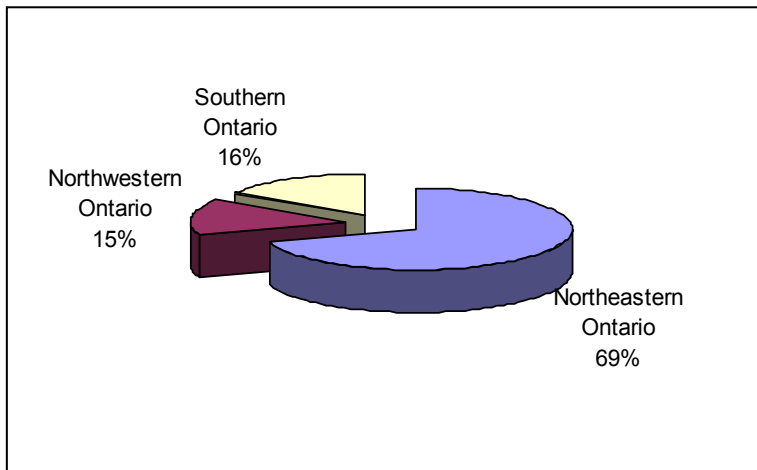
**Figure 14:** The forest is an important economic resource and supports a host of activities<sup>50</sup>.

<sup>50</sup> Timmins regional profile, prepared by Hewick Research Inc.



### The Mining Industry

The mining industry is a vital contributor to Northern Ontario's economy. For instance, non-fuel mineral production in Ontario was valued at \$5.5 billion in 2001<sup>51</sup> and over 95% of Ontario's metal ores and concentrates are exported, providing a valuable source of revenue to the provincial economy. Ontario's mining industry is also a source of job creation for highly skilled individuals. In 2001, the province's mining industry employed 17,744 people of which 843 were in engineering and 681 were in scientific research and development<sup>52</sup>. Therefore, the mining industry is an important receptor of highly trained and skilled scientific individuals. The majority of mining employment is located in Northern Ontario (Northeastern plus Northwestern), as indicated in the following figure 7, and this is supported by the previously reported location quotients. An additional 51,601 and 21,544 individuals were employed in primary metal manufacturing and in the manufacture of non-metallic mineral products, respectively. The average annual income per employee (wages and benefits) was \$93,377<sup>53</sup> and the average weekly earnings in the mining sector was \$1,119 which is considerably higher than the average of Ontario's other industries (\$711) which underscores the importance of the mining industry to Ontario's wealth.



**Figure 15:**  
Regional  
breakdown of  
Ontario's jobs in the  
mining sector

The mining industry is a major contributor to scientific research and has the capacity for significant capital investments in innovation and progress. Ontario's mining industry spent \$62 million on scientific research and development with an estimated \$108.9 million on exploration and a further \$192 million was spent on mine site development in 2001<sup>54</sup>. Ontario's mining industry is also an active partner in several research and capital projects and attracted \$791.0 million in private and public investment in 2001.

The mining industry is also committed to investment in environmental and in bioremediation efforts. In fiscal 2001, the Ontario mining industry spent \$55 million on

<sup>51</sup> Institute for Policy Analysis, 2002 "The Economic and Fiscal Contribution of the Mining Industry in Ontario"

<sup>52</sup> *Ibid*

<sup>53</sup> *Ibid*

<sup>54</sup> *Ibid*

environmental protection, improvement and prevention<sup>55</sup>. The industry is therefore an important receptor of innovation as it is able to sustain significant capital investments. For example, approximately \$1 billion was spent during the 1990s in Sudbury for sulphur dioxide abatement programs. The mining industry has the capacity for large capital projects to improve productivity, reduce costs and to ensure alignment with current national and provincial policies regarding the environment and public health. For instance, the Ontario mining industry is a major stakeholder in the development of new energy solutions as it spent \$215 million on electricity and slightly more than \$100 million on natural gas in 2001<sup>56</sup>. Given that energy is a significant cost driver for the mining industry there is the potential for the adoption and utilization of alternative energy sources, such as those produced from forestry biomass.

As a result of Ontario's global strength in mining, Toronto has become the mine-financing capital of the world. This is an example of the peripheral benefits from the mining industry to the Province and the Nation. An average of \$2.5 billion in new equity capital is raised annually for mining projects through Toronto's banks, brokerages and securities dealers<sup>57</sup>. In addition, the Toronto Stock Exchange (TSX) is a global leader in the mining industry, providing an efficient, liquid market for senior equities. The TSX is home to more than 210 mining companies with a market capitalization valued at more than \$108 billion. Therefore, despite the fact that mining resources are predominantly located in Northern Ontario, there are opportunities for interactions with other areas of Ontario to further grow the provincial value of this resource.

### **The Biohealth Industry**

The biotechnology related health industry is a globally growing market and Ontario is a major force in Canada's biotechnology commercial activities. In 1997 there were 282 biotechnology companies operating in Canada with collective revenues of \$1.1 billion<sup>58</sup>. Approximately 30% of these companies were located in Ontario. As pharmaceutical and biotechnology companies are constantly seeking innovative technologies to fill their product pipelines, the health industry is exceedingly receptive to new initiatives and discoveries. Given the increasing demand for new products and technologies the market opportunities continue to grow. Table 6 provides current and future market estimates for several sectors in the health industry. Northern Ontario has recognized this growth potential and is taking steps to participate in this industry.

---

<sup>55</sup> Institute for Policy Analysis, 2002 "The Economic and Fiscal Contribution of the Mining Industry in Ontario"

<sup>56</sup> *Ibid*

<sup>57</sup> "Ontario's world-leading mining industry" [www.2ontrio.com/industry/mining.asp](http://www.2ontrio.com/industry/mining.asp)

<sup>58</sup> Stats Can, 1997

**Table 14: Global market estimates for the health the industry<sup>59</sup>**

<b>Established Sectors and Subsectors</b>	<b>2001 Global Market (\$US)</b>	<b>2005 Estimated Global Market (\$US)</b>
Enabling Technologies (Genomics, Proteomics, Pharmacogenomics, Bioinformatics)	\$7.6 B	\$17 B
E-health	\$16 B	\$370 B
Pharmaceutical	\$337.2 B	\$506 B
Medical Devices	\$130 B	\$170 B
<b>Total</b>	<b>\$494.3 B</b>	<b>\$1.1 T</b>

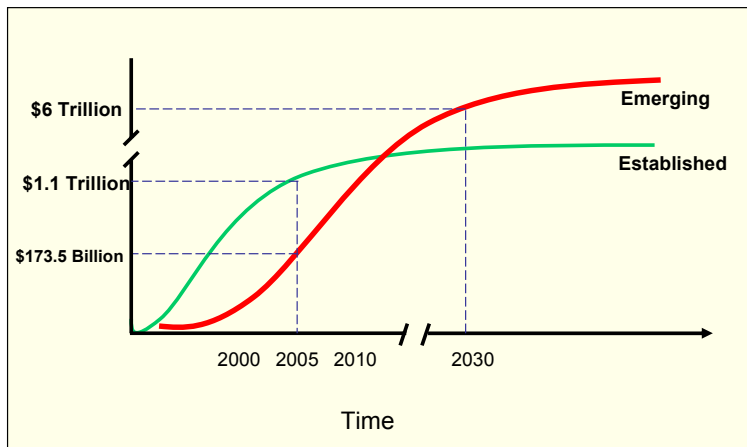
SHI Consulting has also compiled data that forecasts a \$173.5 billion global market in emerging technologies over the next 5 years that will grow to \$6 trillion by 2030 (Table 15). These emerging technologies include fields such as medical robotics, biosensors and biomaterials. A number of these areas have been identified as strengths for Northern Ontario and represent excellent areas for continued biotechnology growth in the region. For instance, the mining industry has developed expertise in robotics that has been adopted for space exploration and soon could provide benefits to the health sector. The growth of the emerging life sciences sector has been charted in comparison to the established health industry (Figure 16). These projections reveal the expanding market opportunities that will be important to Northern Ontario's economy in the coming years and decades.

**Table 15: Global market size for the emerging life sciences sectors<sup>60</sup>**

<b>Emerging Life Sciences Sectors</b>	<b>2005 Global Market Size (\$US)</b>	<b>Estimated Annual Growth Rate</b>
Biosensors	\$5.4 B	35%
Biomaterials	\$80.5 B	30%
Stem Cell Technologies	\$66.4 B	35%
Biophotonics	\$8.0 B	45%
Microfluidics (Biochips)	\$1.7 B	20%
Nanobiotechnology	\$500 M	60-75%
Medical Robotics	\$11.0 B	70%
<b>TOTAL</b>	<b>\$173.5 B</b>	

<sup>59</sup> SHI Consulting, 2001 internal data

<sup>60</sup> SHI Consulting, 2001 internal data



**Figure 16:** The expansive growth in the emerging health technologies market

The rapid market expansion for emerging technologies has been charted in comparison to the established health industries (Figure 16). The emerging health technologies present an excellent opportunity for Northern Ontario to capitalize on its growing health assets. Health related assets in Northern Ontario that support the continued entry in to the biohealth marketplace include:

- Clinical trial capacity
- Access to the First Nation's communities
- Research capacity at the academic, not-for-profit and industrial levels
- A global cluster of expertise in mitochondrial DNA and mitochondrial medicine
- A new medical school which will continue to grow and leverage the existing health assets in the pan-Northern region

### **2.4.3 Education and Skills Profile for Biotechnology and Related Convergent Industries**

The pan-Northern region is home to several Universities and Colleges which provide scientific training and expertise in numerous biotechnology-related fields. A complete listing of academic assets for the region is provided in the Step 1, Regional Profile document. In Step 2, only identified institutions offering biotechnology related training programs are included. It is noted that the academic programs in Northern Ontario are aligned with the regional demands of industry and are therefore responsive to the training needs of the region.

#### **Lakehead University**

Established in 1965, Lakehead University is a comprehensive institution with 6,200 full-time and part-time students, as well as 1,600 faculty and staff. It offers a broad range of programs within seven faculties: business administration, education,

engineering, forestry and the forest environment, science and environmental studies, social sciences and humanities, and professional studies.

Since 1998, Lakehead University has offered an Applied Bio-molecular Science Program, with 23 and 34 students enrolled in 2002 and 2003 respectively. This program is a cross-disciplinary program that enables students to "develop basic knowledge and hands-on skills in modern applications of biomolecular research in Chemistry, Biology and Anthropology" and prepares students for careers in biochemistry, molecular biology, microbiology and biotechnology. Furthermore, since 1999, Lakehead University's Paleo-DNA Laboratory has offered a hands-on intensive Ancient DNA Internship Program. This program provides graduates with training in molecular biology techniques on the most advanced equipment available. It also offers a Masters degree in public health and will offer a Doctorate in Forest Biology by 2005. In addition, it is considering offering a doctorate in life sciences.

There were 522 students who graduated from engineering, science and health-related programs and obtained a Bachelor or Masters of Science degree in 2002. Of those graduates, 17 students received science-related master's degrees. The biological sciences, engineering and forestry enrolment was 790, 683 and 152 students respectively in 2003, while the number of graduates in the same programs was 140, 223 and 65 in 2002.

In the biotechnology related subjects, Lakehead University offers M.Sc. programs in biology, chemistry, geology, mathematics, and physics. Lakehead does not currently offer degrees at the doctorate level.

Lakehead University is well-positioned to provide high quality, well-trained students to biotechnology firms. As well, it offers formal laboratory and research methodology courses to its students. Given the small class size and restricted competition for the use of the research equipment, these students receive significant training on fundamental research equipment. Lakehead University has indicated a strong willingness to accommodate biotechnology firm needs through curriculum development. A sign of the success of Lakehead's education programs is the employment rate of 100% of the graduates (1999) in the biological, computer and physical sciences within six months of graduation.

### ***Laurentian University***

Laurentian University offers several programs directly and indirectly related to biotechnology. In 2002, Laurentian maintained an approximate student enrolment of 6,000. In terms of biotechnology and scientific training, the University's 2002 enrolment included approximately 300 students in agriculture/biological sciences, over 500 in health sciences and over 1,000 in the general arts and sciences. The science programs offered at Laurentian include psychology, gerontology, earth science, and sociology. More specifically, sciences and engineering degree programs includes biology, chemistry, biochemistry, geology, physics, environmental earth science, computer science and others. Laurentian University also offers several professional programs such as e-business science, commerce and administration, midwifery, native human services and nursing.

At the graduate level, master's programs are offered in engineering, biology, chemistry, geology, human development, nursing, applied physics, and geology. The University is

actively seeking the development of several Ph.D. programs; these include Earth Sciences (already approved), Biomolecular Sciences (to be started in September 2004 and under the lead of the Chair in Cancer Research – a partnership established in 1999 by the Northeastern Ontario Regional Cancer Centre, Laurentian University, and the Sudbury Regional Hospital), Boreal ecology, mining engineering, health, and applied human sciences.

To further strengthen its biotechnology and science training programs Laurentian University is partnering with Science North to offer a one-year graduate diploma in Science Communication. Laurentian University and Science North will merge interdisciplinary theories with practical experience and knowledge.

### **Algoma University College (AUC)**

AUC is an affiliate college of Laurentian University and offers degree programs offered in the social sciences and natural sciences. Currently AUC does not offer a complete four year degree (B.Sc) in the sciences but is actively looking to introduce several four year degree programs. AUC is growing in its teaching and research capacity, particularly in forestry-related subject areas. For instance, AUC and the Great Lakes Forestry Centre (GLFC) have recently entered into a Memorandum of Agreement (MOA) in life sciences research and education. The AUC will have access to the world-class laboratory facilities at the GLFC for teaching and research purposes. Additionally, the GLFC scientists will encourage the growth and development of academic programming at the AUC. Recent initiatives within this collaboration include applications to the Canadian Foundation for Innovation and to the Canada Research Chairs program.

### ***Nipissing University***

Research at Nipissing University is actively supported through internal grants, reduced teaching loads, and the establishment of research institutes. Science-related departments include: biology, computer science, geography, liberal science program, mathematics, and psychology. It is anticipated that in certain areas, including biological sciences, Master's programs will be developed within the next four years. The presence of on-site graduate students will significantly increase research capacity. The University has targeted science and research as a priority area for strategic investment. For instance, in 2002 a \$11.2 M expansion was completed at the University with support from the Superbuild fund. The majority of this investment was devoted to scientific programs including teaching and research laboratories and scientific equipment. In addition, technical support and tenure-track appointments within the science faculty have been made with more slated for 2004. Currently, the University is actively searching for tenure-track positions in Analytical Chemistry and Molecular Plant Biology.

### ***Northern Ontario Medical School (NOMS)***

The development of the Northern Ontario Medical School (NOMS) will significantly enhance the biomedical training and research capacity in Northern Ontario and will generate spin off benefits for biotechnology across the region. The inaugural class of the Northern Ontario Medical School (NOMS) will commence in September 2005. The School is a collaboration between Lakehead and Laurentian Universities<sup>61</sup>. It has been indicated that NOMS will focus on rural health initiatives and will encompass teachings in telehealth and other issues related to distance training and clinical practice.

---

<sup>61</sup> [www.normed.ca](http://www.normed.ca)

Though not finalized, the research priorities of NOMS will be broad in scope and include biomedical, clinical, public health, population health, epidemiological, psychological and social sciences and health services research<sup>62</sup>. In this regard, the specific research initiatives will depend on the incoming faculty. NOMS is currently filling 20 full-time faculty positions, including 14 basic and 6 scientists. Each of the scientists will retain protected time for research. The scientists will access approximately 10,000 square feet of wet and dry research space, housed within the NOMS buildings at Lakehead and Laurentian Universities. Additional recruitment plans include the hiring of 600 part time staff over the next 2 years. These employees will be based at both the Laurentian and Lakehead University campuses.

### ***Canadore College***

Canadore offers a nationally recognized Biotechnology Program consisting of two years at the college followed by a year of field placement. This program, which utilizes state-of-the-art teaching technology, offers direct entry into industry. Industry placements have included companies such as Cangene, Apotex, Hemosol, the MDS group of companies and various government agencies such as the Canadian Food Inspection Agency. Canadore's employment training encompasses several sectors of the industry including: research and development, clinical trials, manufacturing, quality control, and federal regulation. The biotechnology program at Canadore represents an integrated educational environment that spans several scientific disciplines including: cell biology, chemistry, physics, molecular biology, genetics, biochemistry, microbiology, immunology, fermentation and bioinformatics. The highly qualified professors and instructors have industry and academic expertise in medical technologies, genomics, molecular cytogenetics and bioinformatics.

### ***Cambrian College***

Cambrian College provides students with a variety of courses in applied arts and technology. Programs combine theory with hands-on experience. A proposed new degree in Biotechnology is to be offered in partnership with the Northern Centre for Biotechnology and Clinical Research (NEUREKA!) and would further develop educational and applied research opportunities. In 2002, over 60% of the Cambrian College's 1,898 graduates were from a science and technology program.

### ***Collège Boréal***

Collège Boréal focuses on advanced technology and innovation and is a leader in integrating notebook computers and video conferencing methods. Their Natural Sciences programs focus mainly on forestry. One of the most prestigious institutes is the CEFNO (Centre of Excellence for Forestry in Northern Ontario). It encompasses several training aspects of the forestry industry from research and development to practical training.

### ***Sault College of Applied Arts and Technology***

The college offers programs in applied arts, business, health and technology, with applied arts and technology reporting an enrolment of 2,135 in 2003. Collaborative programs in nursing are available.

---

<sup>62</sup> Dr. Roger Strausser, Dean of NOMS, August 2003 ([www.normed.ca](http://www.normed.ca))

### **Confederation College**

Confederation College hosts a full complement of science and technology programs. The forestry and environmental technology programs provide graduates for biotechnology applications focusing on forestry and bioproducts.

### **Northern College**

Northern College has programs in human and health services and the social services areas. As well, Northern College is home to the world-renowned Haileybury School of Mines (HSM). The College's 2,000 graduates are currently pursuing careers in mining and mining-related fields throughout North America and around the world. Northern College has also provided expertise to mining in Zimbabwe and Chile, and has taken the lead on numerous international mining education and training projects.

## **2.4.4 Research Excellence**

There are 3 major universities in Northern Ontario that conduct research and provide an academic infrastructure for discovery research. Nipissing University is currently growing in research capacity and has successfully obtained some NSERC funding (less than \$50,000 was reported for 2001). Lakehead and Laurentian Universities are the dominant, academic research strengths of the region. The table below summarizes the funding levels and sources. In addition, both the Northeastern and Northwestern Ontario Regional Cancer Centres are building research capacity at both the clinical and basic research levels.



Table 16: Summary of research funding (cumulative to date, see note at bottom of table)

Institution (Include All)	Annual Funding (\$ Millions)	CIHR Funding (\$ thousands)	CFI Funding (\$ thousands)	NSERC Funding Relevant to BCIP (\$ Millions)	Genome Canada Funding (\$ Millions)	Provincial Funding Relevant to BCIP (\$ Millions)	Other Incl. Private Sector & International (\$ Millions)
Lakehead Univ	14.4	379	824	2.2	0	matching of CHI funds	1.3
Laurentian Univ	9.3	99	362	12.7	0	1.6 (ORDCF) matching of CFI funds	7.1 (research contracts)
Nipissing Univ	N/A	0	0	0	0	N/A	
Northeastern Ontario Regional Cancer Centre	1.2	0	0	0	0	N/A	1.2
Northwestern Ontario Regional Cancer Centre	N/A	18	0	0	0	N/A	N/A

Note: CIHR Funding is relevant from 2000 to present; CFI funding is relevant from 1997 to present; NSERC funding is relevant from 1991 to present.

Several Canada Research Chairs were identified at Lakehead and Laurentian Universities and these are listed below. In some cases it should be noted that the chairs may be held jointly between institutes as is the case with Mining Innovation,

Table 17: Canada Research Chairs at Lakehead University

Name	Research area
Michel Bédard	Psychosocial Behavioural Research – General
Lionel J.J. Catalan	Chemical Engineering
Gary A. Genosko	Sociology
Ellie Prepas	Evolution and Ecology
Heidi Schraft	Molecular Food Microbiology

Rehabilitation and Applied Research Corporation (MIRARCO), the Northeastern Regional Cancer Centre and Laurentian University. The research chairs highlight the research strengths of Northern Ontario, which include forestry, mining and health.

**Table 18: Canada Research Chairs at Laurentian University**

Name	Research area
Madhur Anand	Evolution and Ecology
Gustavo A. Arteca	Biomolecular modeling, molecular structures and dynamics
Gregory R. Baiden	Mining and Mineral Processing
John Gunn	Evolution and Ecology
Michael Leshner	Mineral exploration research, magnetic systems, tectonics and ore formation
Amadeo Paressenti	Cancer research
Peter Kaiser	Geomechanics, mine tunnel stability
Aseem Kumar	Molecular Biology
Graeme Spiers	Environmental monitoring, environmental chemical analysis

Several other not-for-profit and private research institutes are active contributors to research activities in Northern Ontario. A detailed account of these initiatives was provided in Section 4 of the Step 1 document submitted to MEDT.

#### **2.4.5 Technology Transfer, Commercialization and Venture Capital**

Technology transfer in Northern Ontario is primarily supported by Lakehead and Laurentian Universities. It should be noted that the Northern Centre for Biotechnology and Clinical Research (NEUREKA!) is also developing capacity in intellectual property management and technology transfer that could be accessed by a variety of regional initiatives. Laurentian University does not currently have any patents, and consequently no licensing revenue. However, there were 5 disclosures of invention in 2003. Lakehead University participates in the AUTM survey and these results are presented in the Step 1 document. Briefly, Lakehead University has two people dedicated to technology transfer (one of which focuses on licensing, a lawyer licensed in Ontario) and another that provides business expertise (a Chartered Accountant). Lakehead had one invention disclosure, two patent applications, one new patent application and one US patent issued, as of 2003. Lakehead University also had one biotechnology spin-off company. Overall, the academic community of Northern Ontario appears to be well serviced for technology transfer as the commercialization needs of the region are met by the infrastructure provided by the local universities.

In terms of financing, the regional profile failed to identify any biotechnology investments within the total cumulative investment of \$20.4 million (1996 to 2003) that was recorded in Northern Ontario sectors<sup>63</sup>. In addition, there does not appear to be any angel investor networks currently operating in the region. However, a number of provincial and federal sources of investment are available in Northern Ontario and are highlighted in the Step 1 document. Overall, the limited amount of capital investment in biotechnology is a weakness of the area. However, this situation may change as biotechnology continues to grow and gain prominence in the region. For instance, the Ambassador's Northwest group in an informal investor network that operates in Northern Ontario.

<sup>63</sup> [www.cvca.ca](http://www.cvca.ca)

### **2.4.6 Additional Supporting Infrastructure**

As outlined in the Regional Innovation Profile document (Step 1), Northern Ontario has extensive infrastructure and resources available to support the growth and establishment of biotechnology companies. Building on traditional and emerging strengths, the region is poised to become a leader in the use and application of biotechnology. Examples of this infrastructure include:

- Extensive forestry research activities and manufacturing infrastructure
- Global strengths in mining research and capacity
- Significant growth in medical research and teaching capacity
- A cluster of mitochondrial DNA expertise
- Clinical trial services and infrastructure
- Clinical laboratory testing services
- Intellectual property services
- Telecommunications services (e.g. Ontario Research and Innovation Optical Network (ORION))

## 2.5 Biotechnology and Related Industries SWOT Analysis

A complete description of the regional strengths, weaknesses, opportunities and threats is provided in Step 1. What follows is an analysis of the SWOT analysis that was used to build the areas of competitive advantage and establish those initiative areas from which to move forward.

The academic training facilities in Northern Ontario, both universities and colleges, effectively serve the needs of the local industry and provide the necessary supply of trained people to support a growing biotechnology industry. One important factor towards for the future growth of biotechnology in the north is the ability to not only train personnel, but also to retain these people in challenging local job opportunities. At present, unemployment in Northern Ontario is higher than the provincial average (Step 1 document, section 1.2) and is a significant barrier in retaining and developing local talent.

Technology transfer capabilities exist at the local universities and are currently building capacity to meet the demand. Currently, an unmet need was not observed in the supply of technology transfer services and it is anticipated that the existing services will be sufficient to meet the demands of a growing biotechnology industry in the short to medium term. To date, technology transfer activity has been limited by the quantity of local basic research, despite the fact that research funding to local universities has been growing at an impressive rate. While the regional development of innovation is important to the development of a biotechnology industry, there is also an opportunity to consider importing innovation from other regions and developing and commercializing this innovation in order to increase industrial productivity.

Despite the limited availability of private sector funding, such as venture capital, Northern Ontario has access to funding mechanisms that will support the growth of the biotechnology industries. In particular, the mechanisms that exist to support SMEs are important to facilitating a greater shift to a vibrant biotechnology industry.

Northern Ontario's traditional industries and resources provide a base for accepting biotechnology innovation that is unparalleled across Canada, if not the world. The vast biomass assets, combined with the local forestry industrial base in wood and fiber processing, are key strengths to be leveraged into leadership of the emerging bioproducts industry. Mining is another key area of unsurpassed Northern strength, with the Sudbury-Timmins corridor being one of the true globally leading mining regions of the world. However, one challenge faced by Northern Ontario is that a significant amount of the research and development occurring within the forestry and mining industries is occurring outside of the local area. For example, Inco operates one of its major research and development facilities in Mississauga, and significant aspects of Tembec's research and development activities occur in Quebec. In addition, the perception of mining and forestry as traditional and declining industries is one that will have to be overcome as these industries are transformed into knowledge-based industries through the acceptance of biotechnology. These industries are also impacted by many external factors that can make the timing for investment by the players difficult.

For example, the current climate within the forestry industry is not one that encourages long-term investment and strategic planning.

Healthcare is an important industry in the north, especially as a provider of services. At present, this industry is not built on the export of services or technologies and as such the local market for innovation is limited. Globally however there is a great demand for biomedical innovation and the emerging nature of this market opportunity makes it one that Northern Ontario cannot afford to ignore.

A summary of the SWOT analysis, as presented in Step 1, is diagrammed below.

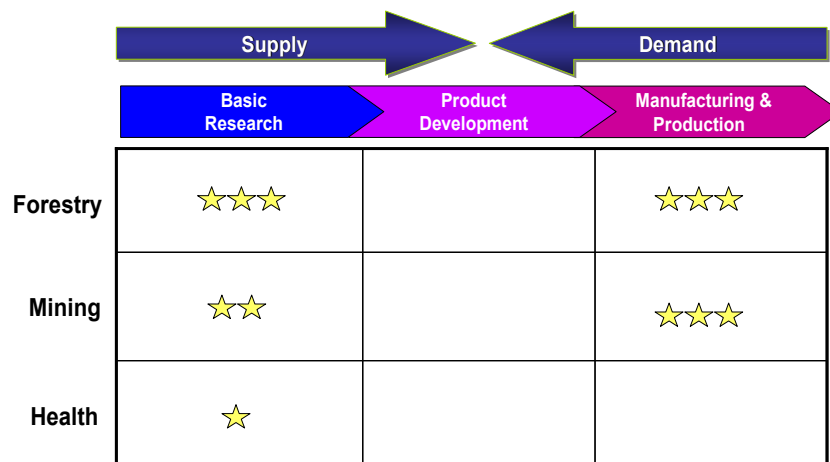
Strengths	Weaknesses
<ul style="list-style-type: none"> <li>• Northern Ontario contains 90% of Ontario's land and a vast biomass resource</li> <li>• A highly developed forestry industry that is engaged in research and product development</li> <li>• A global mining cluster that is technology driven and supports research and development</li> <li>• World-class traditional industry base that is positioned to accept biotechnology innovation</li> <li>• The mining industry is actively involved in bioremediation projects and willing to use biotechnology to improve environmental impact</li> <li>• A strong network of linked healthcare providers and professionals that support clinical trial activity</li> <li>• The region is dedicated to strengthening its basic research capacity, particularly in health research</li> <li>• Technology transfer capacity, provided by local universities supports the regional, academic needs</li> <li>• Convergence between the mining and forestry industries in environmental efforts</li> <li>• Strong network of universities and colleges</li> <li>• Established industries (forestry and mining) are willing to uptake biotechnology innovation</li> <li>• Several dedicated funding sources (FedNor, Northern Ontario Heritage Fund Corporation)</li> </ul>	<ul style="list-style-type: none"> <li>• Basic research capacity, particularly at the academic level, is limited compared to other regions</li> <li>• Limited venture capital investment for local biotechnology initiatives</li> <li>• The health sector is primarily a service provider, but basic research capacity is emerging</li> <li>• Industry sponsored research is often undertaken in other regions</li> <li>• Unemployment levels are higher in Northern Ontario and there are lower numbers of highly qualified individuals compared to the rest of the province</li> <li>• Limited commercialization and creation of spin-off initiatives compared to Southern Ontario</li> <li>• A comprehensive inventory and understanding of the sustainability of forestry biomass is currently lacking</li> <li>• The forestry industry is currently operating within a challenging financial environment</li> </ul>

Opportunities	Threats
<ul style="list-style-type: none"> <li>• The current, global shift to a bio-based economy - a focus of the federal government</li> <li>• Availability of funds for environmental initiatives</li> <li>• Compliance with the Kyoto accord to reduce greenhouse gas emissions             <ul style="list-style-type: none"> <li>◦ The ability to generate and sell carbon credits</li> </ul> </li> <li>• Establishment of a Northern Medical School, bringing teaching and research (clinical) infrastructure to the region</li> <li>• Paradigm shift to bio-diesel and other green energy sources</li> <li>• To become a technology diffusion, or technology demonstration centre for pilot projects and innovation adaptation</li> <li>• The growing need for bioremediation capacity and innovation</li> <li>• Leveraging local networks and diverse communities to a clinical research centre</li> <li>• Ability to leverage biomass resources and expertise in bioprocessing skills (plant and wood fiber) - potential pilot extraction facility</li> </ul>	<ul style="list-style-type: none"> <li>• Competition from existing and emerging clusters and centres for research dollars and skilled people (e.g. India, China)</li> <li>• Declining biomass resources</li> <li>• Increasing global competition in base metal and forestry commodities</li> <li>• Challenges in the export market for natural resource based products             <ul style="list-style-type: none"> <li>◦ Strength of the Canadian dollar</li> <li>◦ Tariffs</li> <li>◦ Fluctuating commodity prices</li> </ul> </li> <li>• Youth out-migration and loss of the most educated, skilled workforce</li> <li>• Aging population</li> </ul>

## 2.6 Identification and Analysis of Niche Biotechnology Areas

### 2.6.1 Identification of Industry Strengths and Gaps

The biotechnology strategy developed for Northern Ontario is based upon building from regional strengths and responding to the needs of local industry. As shown in Figure 17 (below), there is significant demand for innovation in product development in the forestry and mining sectors that are driven by the local strengths in the downstream components of the value chain (i.e. manufacturing and production). Northern Ontario is a leading region in the availability of raw materials for the resource-based industries and this has led to strengths in the processing of these materials into higher value-added products. For example, the Greater Sudbury Area is not only a leading supplier of mineral assets, but it is also home to Inco’s assets in the refining of nickel. In the forestry industry, Northern Ontario is not only home to some of the world’s largest forest assets and biomass, but it also home to some of the leading processors of biomass, such as Bowater, Domtar, St. Mary’s Pulp and Paper and Tembec. This “pull” or demand-driven approach has been utilized to look for the application of biotechnology to the future needs of the local industries. The strength of the existing resource-based industries in Northern Ontario provides an excellent foundation for the potential utilization and adoption of biotechnology innovation. However, there is a continual need to apply resources to ensure the retention of these companies within the local area, as well as to attract new companies to locate in Northern Ontario.



**Figure 17: The biotechnology product development value chain for Northern Ontario’s leading industries. The stars indicate the relative level of strength at each stage.**

Significant assets in basic research exist throughout Northern Ontario in the forestry and mining industries. In some cases, this innovation is occurring within the local companies and is subsequently applied in their manufacturing and production operations. However, the innovation in forestry and mining occurring within the public institutions, for example provincial and federal research institutions and local universities and colleges, is not being effectively translated into products or processes locally. There is a significant gap in the product development component of the value chain limiting the translation of local innovation into commercial solutions. Initiatives developed for NOBI will address this gap in product and process development.

As Northern Ontario positions itself for increasing economic prosperity in the future, it is essential that opportunities for the application of biotechnology above and beyond the traditional industry strengths be considered. Therefore, the biotechnology strategy that has been developed also takes into consideration the emerging global demand for health innovation, and the potential impact that this could have upon the economic diversification of Northern Ontario. Despite the fact that the local manufacturing and production capacity in Northern Ontario's health industry is very weak, the potential global opportunities are so significant, that the region must position itself for a role in this industry for the future. In order to develop the healthcare industry, Northern Ontario must focus on developing its basic research, as well as its capabilities in product development. For example, a critical mass of local basic research is an important asset in order to attract the healthcare industry to the local area. Pharmaceutical companies and health service companies are attracted to areas with established research, development and manufacturing facilities which therefore have a critical mass. It is also important for Northern Ontario to develop strategies to address the product development gap that exists in the healthcare industry. For example, the further development of clinical assets could be key to attracting healthcare investment.

**Case Study: Boston's Experience in Building a Health Cluster**

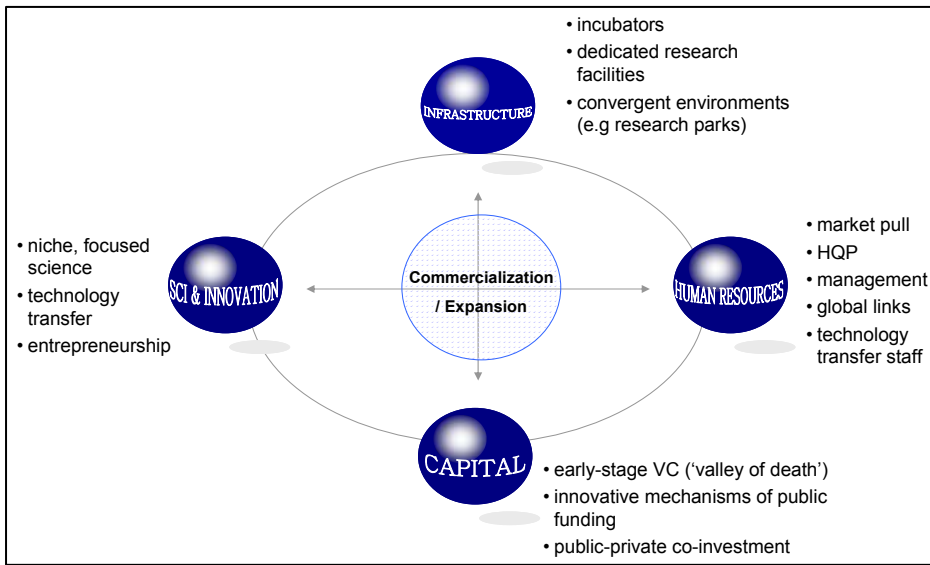
Massachusetts is home to 280 biotechnology companies in the state, 230 of which were founded in Boston. The local industry has grown at a rate of 10% annually for the past five years and 60 local companies are publicly traded. The state has over 218 biotechnology products currently in development. Biotechnology employment in the area is significant, employing approximately 30,000 in 2001. Local universities grant about 350 life-sciences Ph.D.s every year, and there are approximately 5,000 Ph.D. scientists employed in the state, which is believed to be the highest per capita concentration in the world. Key competitive factors for the region include: top researchers at world-class academic centers, sophisticated medical practitioners and an existing core of biotechnology companies. Local research and the existing company base continue to drive activity in the early stages of the value chain. However, current cluster initiatives in Boston are addressing later stage aspects of the commercialization process such as navigating the regulatory system to remain competitive. The current local strategy is to focus on infrastructure development at the next critical stage of the value chain by establishing biomanufacturing capabilities in the western regions of the state.

*Relevance to NOBI: Boston has taken a cluster building approach that involved building capacity as the local need demanded. In other words, they built deep within a value chain and vertically established themselves as world leaders in research and development prior to committing resources to the development of later stages of the value chain.*



### 2.6.2 Identification of Cluster Supply Factors

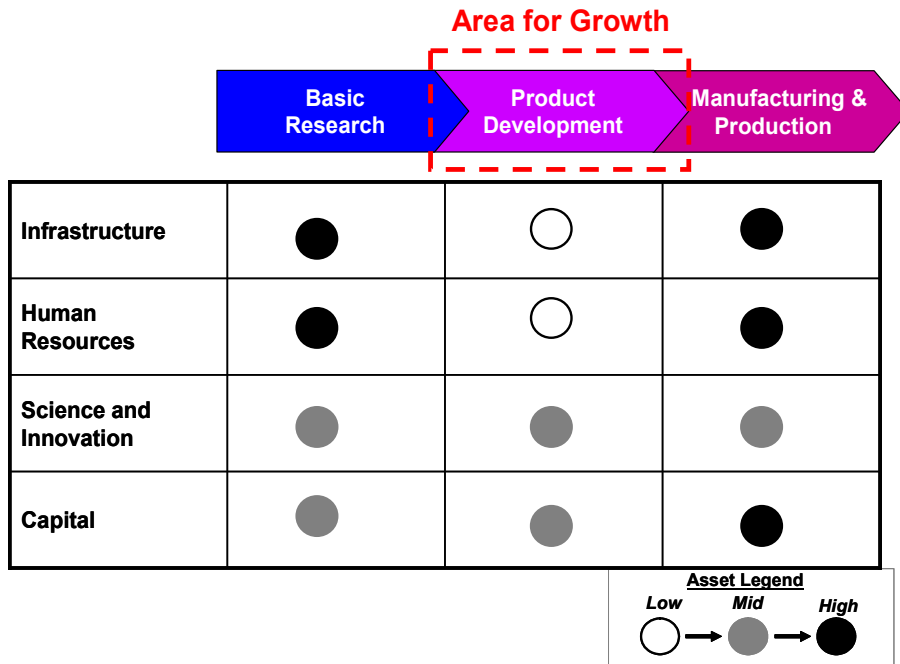
Each of the major industries of Northern Ontario were assessed across the four pillars of supply: science and innovation, infrastructure, human resources, and capital, as described in Figure 18 below.



**Figure 18:**  
The four pillars of cluster supply

Three industry sectors of economic importance to Northern Ontario with the potential to accept biotechnology innovation were identified: forestry, mining and healthcare. Each of these industries is examined below across the four pillars of supply. The supply factors are then integrated across the value chain taking into consideration the previous discussion on the demand factors that are essential for cluster development.

**The Forestry Industry**



**Science and Innovation**

Several large firms such as Abitibi, Bowater, Domtar, Weyerhaeuser, St. Mary’s Pulp and Paper and Tembec are part of the forestry industry in Northern Ontario. Each of these companies invests internally in significant research and development - much of which is considered biotechnology - such as the utilization of waste product streams. For example, Tembec spends approximately \$75 million per year in research and development and it is estimated that approximately \$100 million per year is spent in Northwestern Ontario in forestry-related research. Northern Ontario is also a leader in pest management research. Northern Ontario also has key research strengths in the area of forest management. Of relevance to the forestry sector, there are broad capabilities through Northern Ontario for GIS technology centred on the federal research institutes and the local colleges and universities.

**Human Resources**

Local universities and colleges have developed specialized training programs that provide a workforce for the forestry industry. In addition, the government research centres located in Sault Ste. Marie represent a significant cluster of forestry expertise.

**Capital**

Despite the fact that there is limited venture capital available for high risk ventures in forestry, there are alternative sources of funding available within Northern Ontario including FedNor, IRAP, Sustainable Development Technology programs and the Northern Ontario Heritage Fund Corporation. These funding programs are designed to help companies, especially small to medium sized enterprises, to invest in innovation and to increase productivity.

### Infrastructure

Northern Ontario, with 90% of Ontario's landmass, has a large biomass resource base for the development of industries supported by utilization of the surrounding biomass. This provides an opportunity to take global leadership in the bio-based economy. In addition to the availability of raw materials, Northern Ontario is rich with forestry manufacturing and processing facilities providing the opportunity to increase focus on value-added products. The regional transportation infrastructure is well-developed for the transport of raw and finished materials by road, rail or sea, allowing for continued industry attraction and expansion. The transportation networks provide efficient north-south linkages and access to the United States marketplace.

### Case Study: Finland's Forestry Cluster

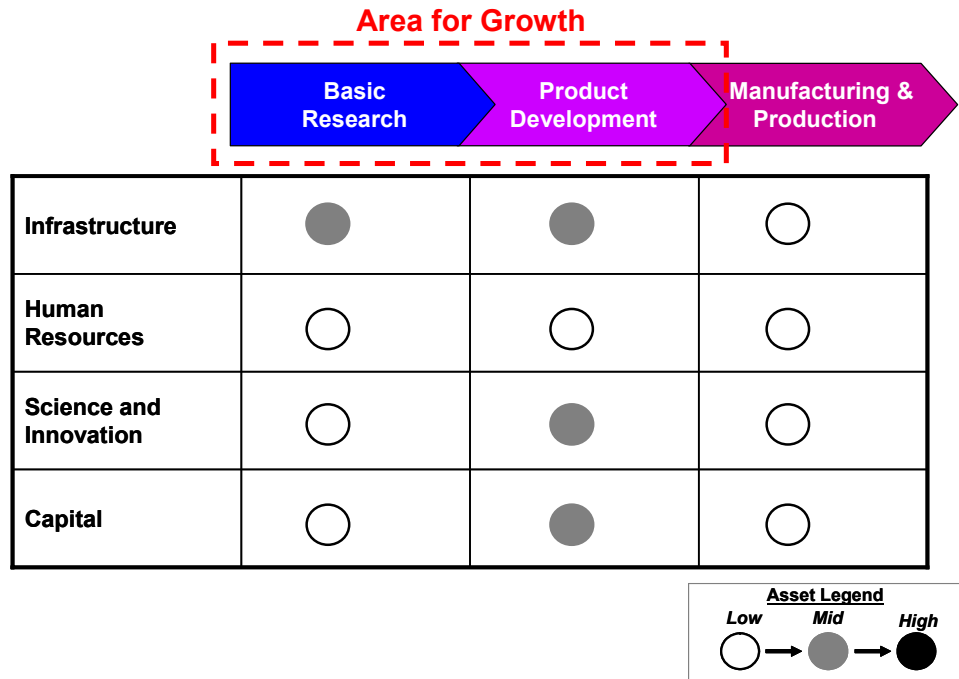
Finland is Europe's most heavily-forested country with 23 million hectares of forests making up 74.2% of the land mass. The forestry industry is the backbone of Finland's national economy employing about 100,000 people. However, the importance of the forestry industry to the Finnish economy has declined from more than 50% of total exports in the 1970s to, currently, approximately 30% as the economy has diversified with products of the metal and electronics industries increasing in export value. The wood resources of Finland have been intensively inventoried and monitored, which may result from the high level of private ownership; unlike Canada, nearly 60% of Finnish forests are private.

The Finnish wood-processing industry began with sawmilling, but the main emphasis today is on pulp and paper accounting for approximately 80% of exports and a record 13.5 million tons of production (up 4.3%) in 2000. The wood-processing industry makes efficient use of the raw material produced from Finland's forests. The mechanical wood processing industry produces sawn timber, plywood, chipboard, fibreboard and building timber. Timber logs are either sawn or veneered to make plywood. Pulp wood is processed into pulp and paper. The topmost part of the tree trunk is chipped for energy production or left to decay in the forest where the nutrients are released back into the ground to fertilize the remaining trees. Sawmills and plywood factories turn about half of the raw material into final products; sawmill waste is sold to pulp and paper mills, and bark and sawdust are used for energy recovery.

The Finnish cluster consists not only of the forestry companies, but also producers of forest industry chemicals, automation enterprises, packaging and printing, energy producers and logistics companies. In particular, approximately one-fifth of the Finnish metal industry's production consists of machines and appliances for the Forest Cluster. This co-operative environment and partnership between the forest and metal industries has given both parties a competitive edge, making many of their products world market leaders.

*Relevance to NOBI: Finland's forestry industry is a vibrant and integrated contributor to the local economy. The forestry assets within Northern Ontario are significant on a global scale and vastly exceed those, such as Finland, who are considered leaders in the forestry industry. In addition, 66% or approximately 70.4 million hectares of Ontario are forested.*

**The Healthcare Industry**



**Science and Innovation**

The health sector within Northern Ontario is predominantly a service industry, rather than a research and technology-driven industry. The scope and scale of research and development occurring within Northern Ontario is low compared to other areas of Ontario. This limited supply of local science and innovation within healthcare will likely hinder the ability of the region to attract biopharmaceutical investment. Within some specialized areas, such as First Nations health and rural medicine, Northern Ontario has the ability to take a leadership position within Ontario.

**Human Resources**

The new Northern Ontario Medical School will help to bring and retain highly qualified people to Northern Ontario. The hospitals in Northern Ontario employ 14,200 highly qualified personnel. However outside of these public institutions there are a limited numbers of highly qualified health professionals. In particular, the region lacks people with experience in starting and growing companies which service or develop products for the healthcare sector.

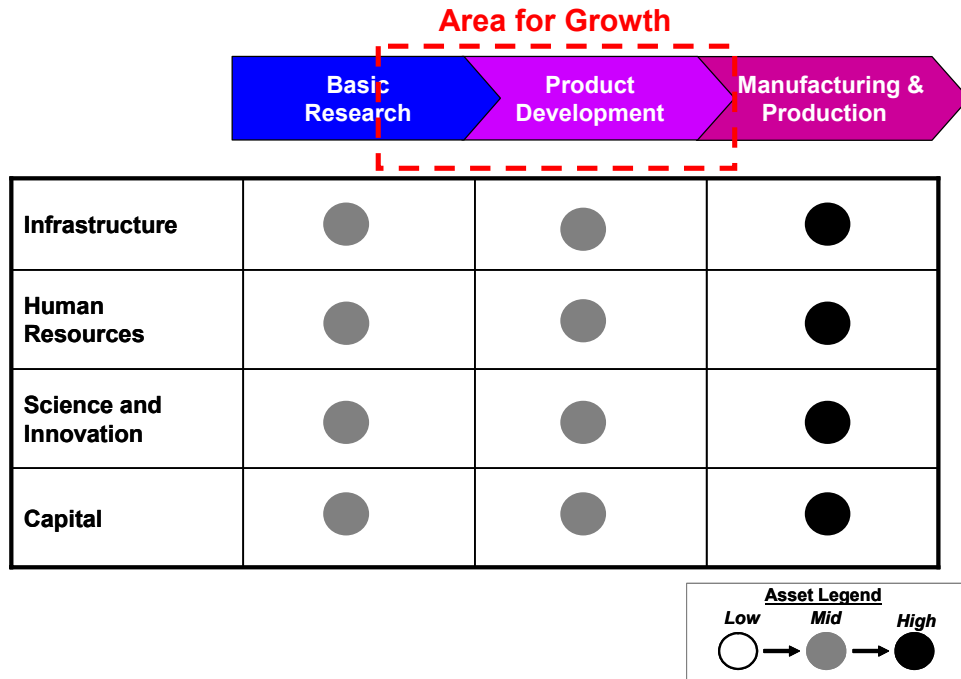
**Capital**

There have been no recorded venture capital investments in Northern Ontario in health-related technologies. Limited access to venture capital may limit the growth of small to medium sized enterprises in this highly capital intensive field. As well, there are few local angel investors with experience in the healthcare sector. Alternative sources of financing for this sector include FedNor and the Northern Heritage Fund.

**Infrastructure**

The infrastructure for the provision of health services located across the region, which includes the universities and colleges, provide a solid foundation for the healthcare industry. Assets for manufacturing and production within the healthcare industry are low. However, the Northern Centre for Biotechnology and Clinical Research (NEUREKA!) is developing clinical trial and incubation expertise that is an asset for further growth of the healthcare industry. Additionally, NEUREKA! and the Northeastern and Northwestern Ontario Cancer centres are expanding in basic research and clinical trial capacity. Other health care centres, such as the Ontario Cancer Care network and the Group Health Centre, add to the regional capacity for clinical testing and population based research. The Group Health Centre has over 60,000 client records with over 70 physicians providing an electronic medical record inventory that is a key local asset. This growth in health-related infrastructure is expected to continue through the establishment of the Northern Ontario Medical School (NOMS). While the healthcare industry does not require transportation of large quantities of raw materials or finished goods, the transport of people is essential for the growth of innovation in this industry. Northern Ontario is well-served by road and air allowing for interactivity between Northern Ontario and Southern Ontario, the US, Western Canada and Quebec.

**The Mining Industry**



**Science and Innovation**

There is a strong foundation of local mining research including the Mining Innovation, Rehabilitation and Applied Research Corporation (MIRARCO) and research occurring within companies such as Inco. Current innovation is focused on technologies that improve the efficiency and cost-effectiveness of mining operations, such as the

application of robotics technology. Local engineering companies provide a great deal of the science and innovation, particularly as it relates to product development and scale-up, within Northern Ontario. The local mining industry has invested significantly in bioremediation and biomining activities. For example, local pulp and paper companies and mining companies have cooperated to apply waste paper sludge to mine reclamation areas. Northern Ontario also has significant capabilities in the area of waste management of relevance to the mining industry. For example, Sault College is home to a fully operational waste water treatment facility.

### **Human Resources**

Lakehead and Laurentian Universities provide a skilled workforce for the mining industry. For example, both universities have a strong foundation of programs in engineering to service the needs of the mining industry. The Greater Sudbury Area is home to over 500 PhD holders, providing a strong foundation of highly qualified people for the mining sector.

### **Capital**

Venture capital investments in Northern Ontario in traditional sectors, including mining, amounted to \$20 million from 1996 to 2003. Much of mining innovation is funded internally within the large local players or is guided by the local engineering consulting companies. Alternative sources of funding for small to medium enterprises in mining include the Northern Ontario Heritage Fund Corporation, FedNor, TPC and IRAP.

### **Infrastructure**

The availability of mineral assets is not anticipated to limit the growth of the mining industry in the short term, especially as technology increases the economic viability of mining lower grade ores. Manufacturing infrastructure servicing the mining industry is significant and includes processing facilities and service companies. There is an excellent transportation infrastructure for raw and finished materials to be transported to market from Northern Ontario by road, rail and sea.

## 2.7 Key Strategic Directions, Projects and Initiatives

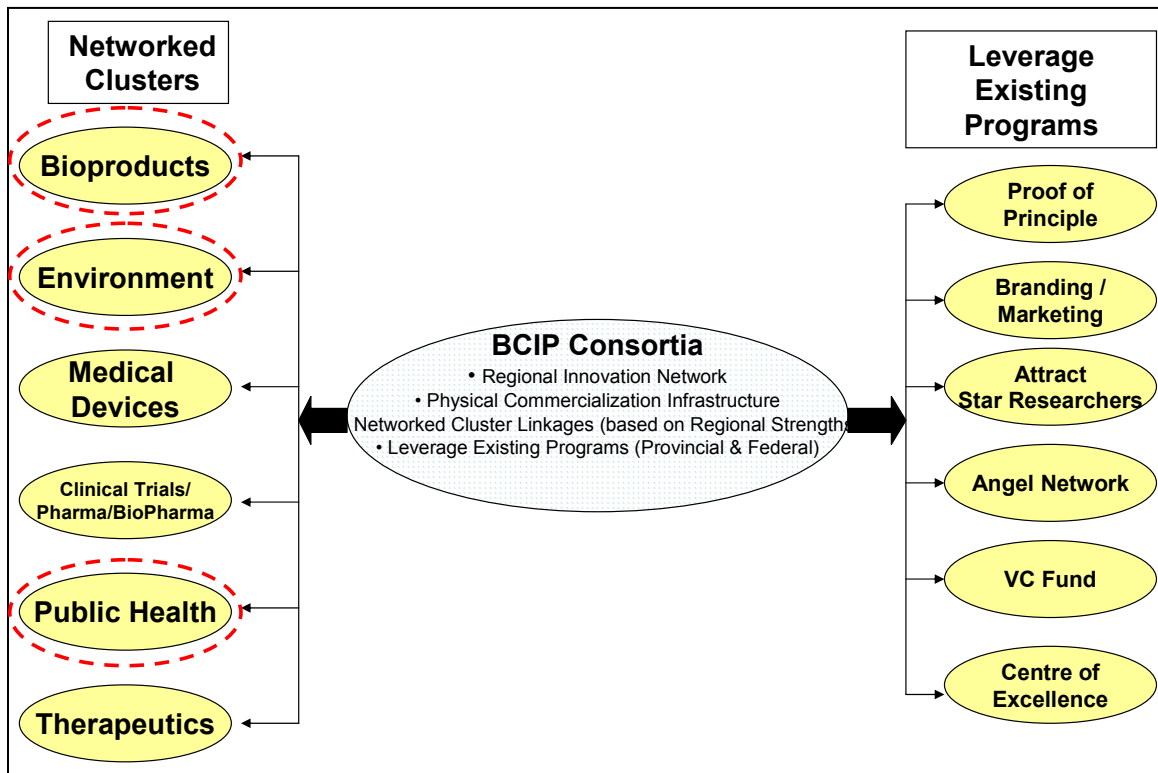
MEDT has identified several areas of subcluster strength in Ontario after review of the submitted Step 1 documents for the BCIP process. An overall model has been developed (Figure 19, below) which identifies the networked clusters based on industry sector on the left hand side. At the centre of this model is the “machine” which a region may develop to focus its efforts and further grow the biotechnology industry. This “machine” can then be utilized to leverage existing programs to continue to grow the regional assets and strengths. These existing programs to be leveraged are indicated on the right side of the model. NOBI has identified three networked subclusters in which the region possesses significant strengths and assets, **bioproducts**, **public health**, and the new **environment** subcluster, which will include biomining and bioremediation.

Northern Ontario is positioned to play a strong role in the **bioproducts** cluster, particularly as it pertains to bioenergy and forestry-related bioproducts. The vast quantity of biomass combined together with the prevalence of value-added production is a key asset for Northern Ontario, allowing the establishment of a leadership position in the biobased economy. Few regions of the world have both the vast supply and the capability to provide value-added production. For example, the quantity of biomass available in Northern Ontario vastly exceeds that available in Finland.

Northern Ontario’s current assets are also very relevant to the **environment** subcluster. NOBI foresees a very strong role in this sector. Several of NOBI’s forestry strengths are directly related to the environment, which includes pest management and reforestation, among others. Northern Ontario is already an established cluster of mining capacity and research, therefore the region is positioned to capitalize on convergent technologies and biotechnology applications as they pertain to the mining industry. The application of biotechnology to mining in the form of biomining and bioremediation will continue to transform the mining industry into a knowledge industry.

Another area of significant strength for Northern Ontario is in **public health**. NOBI has important assets in the growing and important field of mitochondrial medicine. Additionally, in parallel with the new Northern Ontario Medical School (NOMS) the region is building basic research and clinical trial capacity. These efforts will be linked to initiatives in Southern Ontario and play an important role in Ontario’s growth in the biohealth industry.

**Figure 19:** Model for cluster development, networked clusters of major interest to NOBI are circled in red.

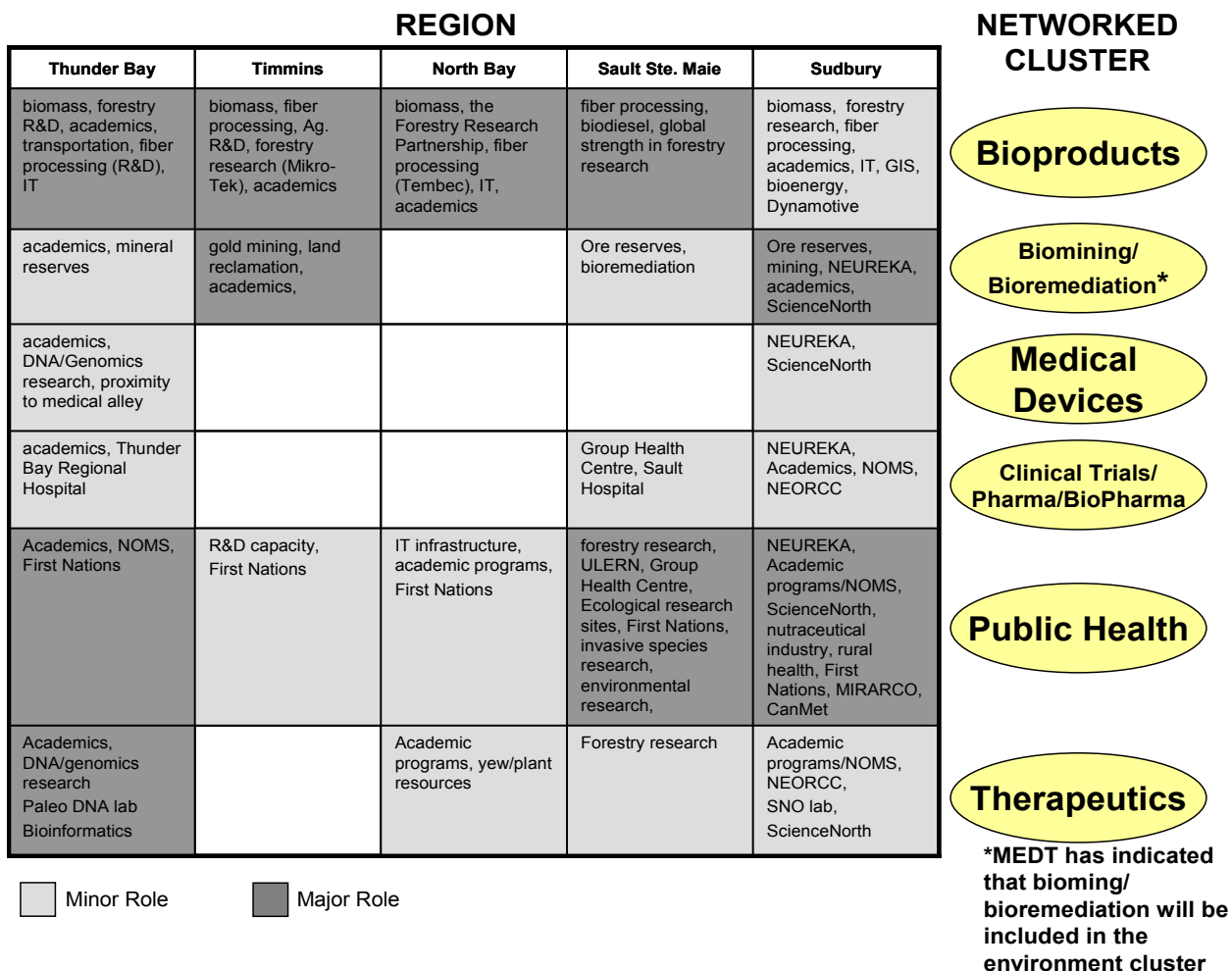


Source: Adapted from MEDT

The regional assets were assessed for each of the NOBI partners and diagrammed below according to where each community identified their interest in playing a major or minor role in the subclusters. Northern Ontario's strengths are diverse and could contribute to each of the subclusters. In the subclusters that Northern Ontario will play a major role there are assets distributed across the communities. From this analysis, it is clear that most regions have significant assets to contribute to the bioproducts subcluster, while Sudbury and Timmins contain the current strengths for a biomining initiative (which would be formed in the newly identified environment subcluster). The assets relating to public health are focused in the three largest northern communities of Thunder Bay, Sudbury and Sault Ste. Marie.



**Figure 20:** Abridged regional asset list pertaining to each of the networked cluster



Source: NOBI steering committee meeting, March 15, 2004

### 2.7.1 Strategic Initiative #1: Building Northern Ontario's Biotechnology Engine

#### Identification of a Need

A need throughout Northern Ontario was identified for greater interactivity among the stakeholders in order to help grow biotechnology within the region. In many cases, the opportunity created for community involvement and interaction through BCIP was the first of its kind. A Regional Innovation Network (RIN) could promote biotechnology in Northern Ontario through:

- Retention of local biotechnology and related companies and attracting new companies to locate within Northern Ontario
- Provision of services in intellectual property, small business support, and technology transfer for researchers and SMEs
- A single marketing voice to promote biotechnology in Northern Ontario throughout Canada and the world

- A unified advocate with the provincial and federal governments to address the further development of biotechnology throughout the north
- A business network to link existing biotechnology companies in Northern Ontario to opportunities throughout the rest of Ontario, Canada and internationally in both the public and private sectors
- Identifying opportunities in Northern Ontario for scientific and commercial development
- A biotechnology job bank
- Promotion of biotechnology training opportunities
- Public education and outreach
- Support the commercialization activities of Northern Ontario's public research institutions through the provision of technology transfer resources and infrastructure

There is some existing infrastructure within Northern Ontario that could be built upon to establish this Network. For example, NEUREKA! has established infrastructure and is providing services across Northern Ontario that could be the foundation for a pan-Northern biotechnology network. The process to establish a pan-Northern biotechnology network would involve some or all of the following activities:

- Identification of an appropriate distributed governance model that could effectively meet the needs of the broad geographic and economic area that makes up Northern Ontario
- Identification of community leaders to form a Board of Directors
- Determination of the specific infrastructure and personnel requirements
- Establishment of a vision, mission and values for the operation of the network
- Creation of an effective virtual environment and presence for the network

### ***Benchmarks and Best Practices***

The concept of utilizing a network or community to grow local biotechnology activity is not new and such efforts have been tremendously successful in other areas. For example, the New York Biotechnology Association (NYBA) is a not-for-profit trade association dedicated to growing the state of New York's biotechnology industries. With a membership of approximately 260 bioscience companies and research institutions, the goal of the Association is to strengthen the regional competitiveness as a global location for biotechnology related industries. Public outreach plays an important role in NYBA's mission. This includes work with community groups and economic development associations. Other services provided by NYBA include technology transfer resources and contact directory, group purchasing programs, increased visibility through NYBA's membership directory, monthly and quarterly newsletters and press releases, legal, regulatory and legislative services, networking opportunities through various events and programs, enhanced industry communications through the Internet.

**2.7.2 Strategic Initiative #2: Major Provincial Role in the Public Health Subcluster**

Northern Ontario is well-positioned to take a major role in the public health subcluster in both the biomedical components of public health, and the environmental or bioremediation components of public health. With the goal of economic diversification and positioning within the knowledge-based economy, Northern Ontario is very interested in taking a major role in the provincial public health subcluster initiatives. Within this subcluster of public health, possible projects for Northern Ontario that would effectively leverage existing assets and strengths are detailed below.

**A Centre of Excellence to Develop Telehealth and Robotics for Clinical Medicine**  
 Telehealth and robotics applications in clinical medicine effectively leverage Northern Ontario's unique strength in

**Case Study: North Carolina's Biotechnology Strategy (Building the Engine)**

North Carolina is one of the top five US states for biotechnology science, commercialization and revenue. Currently, North Carolina houses approximately 10% of the total US biotechnology industry. There are more than 150 biotechnology companies and 75 contract research organizations and laboratory testing companies. Biotechnology companies employ 18,500 workers with a total revenue of approximately \$3 billion. The state plans to continue the growth of the industry, with a targeted 48,000 biotechnology-related jobs by 2013 and 125,000 by 2023. The state has been focused on strategies to cope with the loss of manufacturing jobs in traditional industries.

The strength of North Carolina's biotechnology industry has been the focus of a long-term commitment from state leaders to promote biotechnology innovation and commercialization. Cluster development activities are supported by the not-for-profit North Carolina Biotechnology Center, the world's first government-sponsored initiative in biotechnology development, whose mission is to provide long-term economic and societal benefits to the state. The Center has a staff of 50 and a budget of \$10 million. The Center has provided \$10.6 million in financial assistance to 70 early stage biotechnology companies, who have subsequently leveraged these funds to raise more than \$500 million from other sources. The Center works to recruit, expand and retain biotechnology companies to North Carolina, and to educate a new generation of scientific-literate citizens through a program which has trained more than 1,100 teachers to teach about biotechnology.

North Carolina is the largest producer of Christmas trees in the US and also has significant activities in pulp and paper. An Institute of Forest Biotechnology has been established in Research Triangle Park focused on the appropriate uses of biotechnology in forestry worldwide. Focuses include heritage trees, ecological ramifications, societal issues and outreach.

*Source: "New Jobs Across North Carolina: A Strategic Plan for Growing the Economy Statewide through Biotechnology" January 2004 and Personal Communication with Barry Teater, Director of Corporate Communications and External Relations, North Carolina Biotechnology Center and [www.forestbiotech.org](http://www.forestbiotech.org)*

*Relevance to NOBI: North Carolina's strategy of a coordinated approach to building the biotechnology industry, through the North Carolina Biotechnology Center, has been very successful in transforming an economy heavily reliant on traditional industries into one focused on the knowledge-economy. These objectives in job creation and economic diversification are similar to those of Northern Ontario.*

robotics technology that has been developed for use by the mining industry. Laurentian

### **Case Study: Mitochondrial-Based Health Research**

University in Sudbury has Canada's only Canada Research Chair in Robotics and Mine Automation. As well, the newly formed Northern Ontario Medical School (NOMS) will focus, in part, on rural medicine, and will be an effective platform to both train new healthcare professionals in telehealth technologies and to develop and clinically test new innovations.

#### **A Centre of Excellence to Develop Mitochondrial Medicine**

Thunder Bay, through its Paleo-DNA Laboratory and several private companies, such as Genesis Genomics and Molecular World, has developed an expertise in mitochondrial DNA and its application to human health and disease. In order to develop this Centre it will be necessary to perform a needs analysis in order to identify strategies to promote this Centre and in particular its commercialization activities. Needs of the Centre may include infrastructure, equipment, and/or research expertise. This process would require industrial support.

#### **Establishment of a Tissue and Bone Bank**

Strong community interest exists for the establishment of a tissue and bone bank to service both the needs of the medical and research communities within Northern Ontario, as well as to provide a potential opportunity for export of these materials to researchers around the world. The primary purpose of the tissue bank would be to provide quality bone material to hospitals for transplantation purposes. It would be necessary to establish both the physical infrastructure and equipment for this bank. A related initiative is a centre for storing umbilical cord blood as a source of stem cells with a focus on developing research applications. Such programs exist in other regions, such as Nova Scotia where a comprehensive tissue and bone bank has been established to ensure all Nova Scotians are offered the option of tissue donation and to provide high quality tissue products to Nova Scotian surgical programs.

There are several laboratories around the world performing research on the mitochondria and its implications to human health and disease. Broadly, this research can be divided into three categories:

1. Mitochondrial function and biology
2. Mutations to the mitochondrial genome and the impact in human health
3. The use of the mitochondrial genome for linkage and paleo-genomic tracking

In the United States there are two predominant centres of mitochondria research, both originated from the Emory University Center for Molecular Medicine. These are the laboratories of Dr. Michael Brown, (Mercer University School of Medicine) and Dr. Douglas Wallace (University of Irvine California). A primary consultation with Dr. Brown revealed that his laboratory has published over 100 peer-reviewed articles and receives approximately \$500,000 to \$700,000 US in operational funding per year. This funding is primarily derived from the US federal government (i.e. National Institutes of Health). Dr. Brown currently holds one patent related to specific mtDNA mutations.

A private company has been identified that performs research in mitochondria. Located in San Diego, MitoKor employs approximately 50 people and has raised in excess of \$50 million through venture capital financings since 1992 and currently holds 15 patents. MitoKor is a leader in mitochondrial medicine and is developing therapeutic solutions for diseases, based on mitochondrial research. MitoKor has a broad range of diagnostics and other products in the pipeline. It has successfully partnered with a multinational pharmaceutical company (Wyeth Corporation) to develop estrogens and estrogen-like compounds for the treatment of Alzheimer's disease.

*Relevance to NOBI: Mitochondrial medicine is a nascent area of both research and commercialization. There is an opportunity for Northern Ontario to leverage its existing assets and to cooperate with other research groups to take a leadership position in this field.*

### **2.7.3 Strategic Initiative #3: Major Provincial Role in the Bioproducts Subcluster**

Northern Ontario has an inherent strength in biomass availability combined with industry support and research expertise to develop the emerging bioproducts industry. The forestry and wood product processing infrastructure of Northern Ontario, and the tremendous receptor capacity for innovation of the local industries, are assets for Northern Ontario to leverage. As a global leader in the forestry industry, both in terms of quantity harvested, processing capabilities, and research, Northern Ontario would like to take a leadership position in Ontario's bioproducts subcluster. Possible projects within this bioproducts subcluster that would effectively leverage Northern Ontario's existing assets and strengths are detailed below.

#### **GIS Mapping to Determine the Quantity, Quality and Current Utilization of Forestry Biomass Resources**

Although some activity has been undertaken in the mapping of forestry reserves within Northern Ontario, such research has dominantly focused on timber species and there has been little integration of such knowledge across the public and private sectors. As well, the understanding of Northern Ontario's biomass resources falls short of the knowledge that exists in other provinces, such as New Brunswick which has invested heavily in GIS capacity and innovation. Knowledge gaps exist with regard to biomass of non-timber species and availability of waste streams from forestry operations. This initiative would require an audit of current Ministry of Natural Resources and Ontario Forest Research Institute activities to further understand where information gaps exist. GIS and other imaging technologies, which are available through the colleges and universities in Northern Ontario, would be utilized to conduct a detailed survey, and assets for data analysis and model development include the supercomputing capabilities of Lakehead University in Thunder Bay. A governing council would be established in order to develop strategies for effective utilization of Northern Ontario's biomass and to serve an advocacy role. All regions within NOBI have identified significant assets that could be applied to a pan-Northern GIS mapping project.

#### **Establishment of Commercialization Resources for Bioproducts**

A centre with dedicated facilities including equipment and expertise could help to attract emerging technologies to Northern Ontario. The centre would advocate and promote the development of pilot scale facilities to test and further develop innovation in Northern Ontario, for local application and for export to other regions. The centre would support local small to medium enterprises in utilizing technology and applying innovation, as well as attracting new companies to the area. The centre could have an active business development team to identify research and attract potential technologies to the region and to perform feasibility and economic benefit analyses. This centre could compliment the activities of the Scienceworks! initiative. Sault Ste Marie is working on a partnership opportunity to establish a 50,000 square foot facility. This project will apply early stage technologies to convert solid waste into energy without generating significant greenhouse gases. This proposed initiative to establish commercialization resources for bioproducts will focus on bringing new technologies and innovation to Northern Ontario.

#### **Chemical and Bioactive Analysis of Plant Species of Potential High-Value Chemical Application**

Northern Ontario has a potentially large value in uncharacterized assets in terms of plants and microbes from the boreal forest. For example, the yew tree has been identified as a source of Taxol, an anti-cancer medication. There is an opportunity to inventory and chemically characterize these plants with a view to develop chemical products. These may include industrial chemicals and/or bioactive compounds. In addition, Northern Ontario's First Nations people are a tremendous source of information regarding the medical value of the native plants, and would be a key partner in this initiative. Some inventorying of plants that exist within the forests has been conducted; however such activities have not been focused on collecting samples for chemical analysis. An audit of current knowledge and ongoing activities would be essential to initiate such a project. For instance, it was recently announced that the Northern Ontario Heritage Fund Corporation has recently supported an initiative to evaluate the potential for growing and harvesting the Canada Yew. A research partnership has been formed between the Great Lakes Forestry Centre, the Thessalon First Nation Bio-Centre, the Ontario Forestry Research Institute and the Upper Lakes Environmental Research Network, among others. These are the types of initiatives that will be built upon and promoted with this initiative.

#### **2.7.4 Strategic Initiative #4: Major Provincial Role in the Environment Subcluster**

Northern Ontario has several strengths that are readily applicable to the newly formed environment subcluster and could therefore take a strong position in this subcluster. These strengths include the established forestry and mining industries. For instance, the regional mining industries are recognized as a global cluster of infrastructure and expertise. The mining industry is also a capital intensive industry and is a receptor for new innovations and technologies. There are several biotechnology applications to the mining sector and these include biomining and bioremediation. Potential projects that could fall into the bioproducts and/or environment subclusters are highlighted below. The forestry and wood fiber processing resources are also positioned to play an important role in Ontario's environment cluster. Proposed initiatives relevant to this subcluster are highlighted below.

##### **Development of a Biomining and Bioremediation Research Centre(s) of Excellence**

Northern Ontario is home to a global cluster of mining activity and technologies and there are growing opportunities for biotechnology in this industry. For instance, biomining is a technology that uses bacteria to leach the metals from within the ore and has been used to improve recovery rates and reduce operating costs in some applications. Biomining is currently in practice in various parts of the world and 25% of the global supply of copper, with a price of \$1 billion annually, is produced through this form of bioprocessing. In South Africa, biomining has been adapted to gold extraction and allows for the utilization of low grade ores that would not typically be a profitable resource. Research centres are emerging to study biomining such as the Idaho National Engineering and Environmental Laboratory (INEEL) in collaboration with the US Department of Energy.

In Northern Ontario, the local mining industry is highly engaged in research and development and represents an excellent potential partner. For instance, Inco's 2002 research and development budget was approximately US\$17 million. There are also a number of research strengths present at Laurentian University, (i.e. Dr. Léo G. Leduc,

Laurentian University Mining Automation Laboratory (LUMAL)) and MIRARCO. Several research projects could be initiated that would work to adapt current biomining technologies for use in Northern Ontario. This would include increasing the efficiency of the process at lower temperatures and creating new strains of bacteria that are resistant to the poisonous trace metals found in the metal ore.

The outcome of this initiative would be the establishment of a centre of excellence focused on developing expertise in biomining and developing its application to Northern Ontario. Initially this would begin with a needs analysis (infrastructure, equipment, projected operating expenditures, etc) through consultation with scientific thought leaders. Follow up steps would include establishing a board of directors and a governance model for the research organization and the identification of key researchers to operate within the cluster and the development of a recruitment strategy. One of the main goals would be to identify other mechanisms of support (federal, industrial, etc.) and to develop partnerships with existing local assets.

In addition to developing expertise in biomining, this centre could also study the use of biotechnology for bioremediation purposes. Such applications include the use of microbes (bacteria and fungi), grasses and forestry resources to help in the remediation of areas following industrial activity. The mining activities, present across the pan-Northern region, represent a significant receptor for bioremediation needs. Bioremediation represents a convergence of the forestry and mining industries, particularly in the application of waste biosolids from pulp and paper processing as a support material for bioremediation efforts.

#### **Development of Partnerships and Programs to Assist in Industrial Cooperation Towards Reducing Environmental Impact Based on the Principles of Eco-Industrial Clustering**

The eco-industrial partnership is envisioned to operate as a distributed not-for-profit organization that would provide opportunities for education and research while seeking to improve the environmental and financial performance of small and medium sized enterprises in Northern Ontario. The partnership would work with existing industries, such as mining, metal processing, forestry, and wood fiber processing, in order to identify improvements in waste management and coordination of input/output streams. The initiative would assist in the application of technologies to reduce energy costs, prepare for implementation of the Kyoto accord, and assist in developing waste management solutions. For instance, the Community EcoEnergy consortium is working to design and install an energy self-sufficient anaerobic digester to improve manure handling and to provide an electrical power source. There is the potential for this to become a commercial opportunity. This is the type of projects that an eco-clustering initiative would identify and promote. This eco-industrial initiative would start with a broad scan of current waste stream management practices and perform an audit of the current utilization pathways (input/output streams) of local industry. The initiative may require establishing dedicated space either free-standing or as a part of the local universities and colleges. As well, the initiative could leverage local graduate students and develop co-op programs to provide relevant work experience. Other regions have developed active and vibrant eco-industrial clusters. For example, Burnside Industrial Park in Dartmouth, Nova Scotia is home to an eco-centre that serves the needs of the local industry. The Burnside Industrial Park has 1,500 businesses, 10% of which are in manufacturing. The eco-centre provides environmental reviews, free-of-charge to resident companies, and identifies potential linkages between companies. One measure

of success of the eco-centre is the increasing number of companies involved in repair and recycling activities. Other eco-clusters are gaining momentum, such as the Golden Horseshoe By-Product Synergy, championed by Dofasco and based upon using iron oxide from sludge (steel making waste) as a raw material for cement making.

Other possible initiatives in the environmental subcluster include:

- Pest Control Product Development and Environmental Testing
- Great Lakes Water Quality Research
- Invasive Species Research and Management

### **Case Study: British Columbia's Environmental Business Sector**

In 2000, it was estimated that there were more than 800 environmental firms employing over 22,000 people and generating revenues in excess of \$1.8 billion in BC. Most of these companies are small enterprises employing fewer than 25 people and are clustered in the Lower Mainland of the Vancouver Island/Coast area. These companies represent roughly 12 to 15% of Canada's environmental industry.

The companies are active in providing goods and services to measure, prevent, limit or correct environmental damage to soil, air, water or to deal with the problems of waste management, noise reduction or eco-system protection. Much of the developed technologies and services are provided for export to the United States. The major areas of strength most often cited with respect to the environmental technologies and services sector in British Columbia relate to: water and wastewater services and technologies; alternative energy systems, including fuel cells, clean fuels technologies and biomass/co-generation systems; sustainable resource management, specifically related to forestry and mining reclamation; and environmental instrumentation technologies. Another emerging source of strength is the growing presence of supportive clusters enabling smaller firms in the sector to work jointly with select government agencies, academic and other research institutions. This is a highly research intensive industry as over 75% of the environmental companies surveyed reported some form of basic, applied or developmental research with respect to processes, services or technologies.

Source: [http://www.wd.gc.ca/innovation/etf/rpts/regional/bc/default\\_e.asp](http://www.wd.gc.ca/innovation/etf/rpts/regional/bc/default_e.asp)

*Relevance to NOBI: British Columbia has been able to build a significant environmental business sector which is active locally and internationally. The growth of this knowledge-industry has been the product of British Columbia's traditional strengths in the mining and the forestry industries. Northern Ontario has a similar profile of resource-based industries and the opportunity to foster the development of a broader environmental services sector capable of meeting local industry needs and exporting services.*

## **2.8 Cluster Performance Measures**

The success of Northern Ontario's biotechnology clusters will be measured by the region's ability to create sustainable economic growth.

The success of the biotechnology cluster development activities within Northern Ontario will be assessed by performance measures:

- Building a network of regional expertise and knowledge in biotechnology



- Increased research funding support for biotechnology
- Increased demand for local biotechnology training opportunities
- Increased retention and attraction of small to medium-sized enterprises
- Better understanding of biomass resources and strategies for sustainable resource management
- Development of higher value-add forestry products, leading to a leadership position in value-add/bioproducts research and commercialization
- Increased spin-out activity from local research institutions
- Development of additional laboratory space and equipment
- Strong linkage with other clusters in Ontario and Canada
- Increased employment opportunities in biotechnology throughout Northern Ontario

## 2.9 Next Steps

The strategic process undertaken to date for the Northern Ontario Biotechnology Initiative (NOBI) has identified several key areas of strength for Northern Ontario. Within each of these areas of strength, initiatives will be assessed across a broad range of criteria including:

- Benchmarks and best practices
- Regional leadership potential
- Opportunities for synergies and partnerships (locally, provincially, nationally and internationally)
- Cost feasibility and potential sources of funding
- Local, provincial, national and global impacts
- Timeline to impact of initiative

Based on these criteria, initiatives will be selected from which to move forward and develop comprehensive business cases for implementation by the Pan-Northern Regional Innovation Network.

## **3 - The Business Plan**

### 3.1 Executive Summary

Northern Ontario's natural resource-based economy is in transition as the knowledge-based economy continues to merge with traditional industries. The three major industries in Northern Ontario with significant ability to adopt biotechnology innovations are forestry, healthcare and mining, and these industries will play an important role in increasing Ontario's global competitiveness in biotechnology. The Ministry of Economic Development and Trade's Biotechnology Cluster Innovation Program (BCIP) brought together a broad range of Northern Ontario's biotechnology stakeholders to form the Northern Ontario Biotechnology Initiative (NOBI). Through this collaborative process, the stakeholders defined a Regional Innovation Network (RIN), termed NOBI, that leverages existing assets to create more and greater opportunities for connectivity in Northern Ontario.

*The mandate of NOBI is to promote the adoption and commercialization of biotechnology in Northern Ontario by facilitating and promoting collaborative partnerships that create a two-way flow of knowledge and opportunities between industry and research.* NOBI will provide a central point of contact between biotechnology in Northern Ontario and external stakeholders, thus allowing for greater industry access to local innovation and an opportunity to import technology for application in traditional industries. The programs offered by NOBI will focus on outreach to both the broad biotechnology community and the Northern Ontario public, as well as support for the commercialization activities of research institutions and industry. In order to achieve its mandate and deliver programs and services, NOBI will operate through an Executive Director and specialists with biomedical, bioproducts and environmental expertise. Each of these individuals will have key skill sets in their subject matter, as well as commercialization, networking and marketing know-how, and will be a valuable pan-Northern resource. The Executive Director will play a primary role in creating linkages between Northern and Southern Ontario, and the promotion of Northern Ontario to the global biotechnology community.

Partnerships with local stakeholders will be key to NOBI's delivery of programs and ensuring local community presence. Specifically, NOBI will leverage the biotechnology organizations throughout Northern Ontario as local offices for the sector specialists, and as partners in program and service delivery. Organizations for program collaboration may include not-for-profits such as ULERN, MIRARCO and NEUREKA, regional organizations such as ScienceWorks and the Lakehead Life Sciences Association, and local universities and colleges such as Laurentian University, Lakehead University and the Northern Ontario Medical School (NOMS). Groups with significant local knowledge and expertise, such as regional economic development offices, the Industrial Research Assistance Program (IRAP), FedNor and the Ministry of Northern Development and Mines (MNDM), will be leveraged to ensure local connectivity and up-to-date local knowledge.

While being located within a community with significant assets in their area of specialization, each of these sector specialists will have a pan-Northern responsibility and as such will be responsible for the equitable provision of services to companies across Northern Ontario. As demand for the programs and services offered through

NOBI increases, and as the additional biotechnology critical mass is achieved throughout Northern Ontario, it is anticipated that the Network will continue to expand both to have additional regional presence, most specifically in the communities of North Bay and Timmins who will not initially have local representation, and through the addition of additional sector specialists.

The total budget over the next four years for NOBI is estimated at \$2.8 million, with a **request for \$1.1 million in funding from Phase 2 of the Biotechnology Cluster Innovation Plan (BCIP)**.

Looking to the future, the Network established through the BCIP to create NOBI is simply a starting point for the connectivity of Northern Ontario's biotechnology stakeholders. The success of NOBI will contribute to increase local involvement in biotechnology, leading to increased demand for the Networks' services and further expansion of NOBI. In 2008 and beyond, NOBI will look for new funding mechanisms from Federal and Provincial government sources, local municipalities, industry and other stakeholders, to further grow the Network. First priorities will include greater out reach out to all communities, large and small, by ensuring local, on-the-ground representation in all of the major communities, and the addition of new sector specialists to provide additional specialized services to the larger communities.

## 3.2 Background & Rationale

The Ontario Ministry of Economic Development and Trade's (MEDT) Biotechnology Secretariat developed the Biotechnology Cluster Innovation Program (BCIP) to take advantage of the province's developed asset base in order to sustain and develop global competitiveness in biotechnology. By taking a bottom-up regional approach, the BCIP endeavour is seeding the ability of eleven regions across the province to develop strategies for increasing regional competitiveness in biotechnology and life sciences through funding for strategy development and creation of regional innovation systems.

Phase 1 of the BCIP catalyzed linkages among key regional stakeholders and committed these regional stakeholders to work together in order to strengthen innovation capacity and global competitiveness. MEDT has recently announced that in Phase 2 of the BCIP resources have been specifically allocated towards building regional biotechnology capacity through greater connectivity. The connectivity established through a network of Regional Innovation Networks (RINs) across the Province is envisioned to enable Ontario to transform regional innovation strengths into economic opportunity and growth and allow for the cluster consortia to address their regional goals.

The Northern Ontario Biotechnology Initiative (NOBI) Steering Committee currently consists of 11 members who provide regional leadership in economic development, research, academic excellence and other resources and knowledge relating to the regional biotechnology industries<sup>64</sup>. The NOBI is a concerted and collaborative effort to build upon the existing industrial and research strengths in Northern Ontario and to assist in the growth of the biotechnology industry. The BCIP process has served as a catalyst for Northern Ontario's key biotechnology stakeholders enabling them to develop a proactive biotechnology strategy that leverages the regional strengths. Five communities of Northern Ontario have come together in this collaborative effort to form the Northern Ontario Biotechnology Initiative (NOBI). These communities are:

1. North Bay/Nipissing
2. Sault Ste. Marie/Algoma
3. Sudbury/Manitoulin/Parry Sound
4. Thunder Bay/Northwestern Ontario
5. Timmins/Cochrane/Temiskaming

---

<sup>64</sup> Appendix 1

## 3.3 Overview of Northern Ontario's Sector-Specific Strengths

The NOBI's Step 1: Regional Innovation Profile and Step 2: Biotechnology Cluster Strategy documents prepared for the BCIP identified the key assets in Northern Ontario that could be leveraged for the development of biotechnology clusters. This process, which included community-based consultations and collaboration with subject matter experts, has led to the identification of several important biotechnology sectors for the region. These include forestry bioproducts, mining and environmental technologies, and biomedical.

### 3.3.1 Forestry Bioproducts

Northern Ontario is home to Ontario's forestry industry which is a major source of revenue and jobs for the province. For instance, in 1997 \$15 billion of forestry products were manufactured in Ontario<sup>65</sup>. This wealth of economic benefits and opportunities are derived from Ontario's abundance in forestry resources which constitute 17% of Canada's and approximately 2% of the world's forests<sup>66</sup>. The forestry industry is a major receptor of biotechnology innovation. Other commercial opportunities derived from the forestry sector include the production of innovative bioproducts and bioenergy. As outlined in the Step I and II documents, Northern Ontario has extensive forestry-related assets in terms of industrial infrastructure (mills, fiber processing, and manufacturing) and in terms of highly qualified human resources.

### 3.3.2 Mining and Environmental Technologies

Ontario's mining industry is primarily located in Northern Ontario and is a vital contributor to the provincial economy. For example, mineral production in Ontario was valued at \$5.5 billion in 2001<sup>67</sup> and is a valuable source of jobs and revenue for the province. The mining industry is also an important source of job creation for highly skilled individuals. For example, in 2001 the province's mining industry employed 17,744 people of whom 843 were in engineering and 681 were in scientific research and development<sup>68</sup>. The mining industry is also a major contributor to scientific research and technology adoption.

### 3.3.3 Biomedical

The rapid market expansion for emerging technologies in healthcare represents an opportunity for Northern Ontario to both commercialize novel technologies and to adopt existing innovations. The healthcare related assets in Northern Ontario that support the continued entry into the global biomedical marketplace include:

- Clinical trial capacity

<sup>65</sup> Ontario's Living Legacy Trust, volume 2, original data: Jaako Poyry "Assessment of the Status and Future Opportunities of Ontario's Solid Wood Value-Added Sector. Research Report (26 June 2001) and other volumes.

<sup>66</sup> "The heart of North America's Forest Industry" [www.2ontario.com/industry/forestry.asp](http://www.2ontario.com/industry/forestry.asp)

<sup>67</sup> Institute for Policy Analysis, 2002 "The Economic and Fiscal Contribution of the Mining Industry in Ontario"

<sup>68</sup> *IBID*

- Access to the First Nation's communities
- Research capacity at the academic, not-for-profit and industrial levels
- A global cluster of expertise in mitochondrial DNA and mitochondrial medicine
- A new medical school which will continue to leverage the existing health assets in the pan-Northern region



### 3.4 Operational Model

The NOBI proposes the development of a Regional Innovation Network (RIN). NOBI will be a nonprofit association dedicated to development and growth of Northern Ontario's biotechnology industries, and to the implementation of the various strategies and projects that have been developed throughout the BCIP engagement.

The operational model for NOBI has been built using the framework illustrated above. From a thorough

understanding of regional **needs**, an organization **mandate** was developed. **Programs** that fulfill the mandate were designed and an operational and organizational **structure** to deliver these programs has been developed.



**Case Study:** The Innovation Network is a new approach for the Peace Region in Alberta that was initiated by the Peace Region Economic Development Alliance (PREDA) in July 2001. The Innovation Network has been developed to address the identified gaps in regional innovation, research & development, and commercialization services. It will provide technical problem solving services for regional inventors and entrepreneurs bringing new products to market. Linkages will be developed among regional entrepreneurs, innovators, scientists, business development specialists, mentors and market development specialists. Linkages will also be formed among Peace Region applied research facilities, colleges and existing innovation resources within regional businesses. The Innovation Network will forge formal linkages with the commercialization and innovation support services and personnel throughout the province and, if required, beyond. The Innovation Network will develop Memoranda of Understanding with partner agencies to gain further access to needed resources. In addition, The Innovation Network will foster the development of a culture of innovation for new entrepreneurs and within existing businesses.

### 3.5 Regional Needs

The needs of the local biotechnology stakeholders have been broadly placed into three categories:

1. Industry Needs
2. Research Needs
3. Other Needs (needs that are applicable to the pan-Northern community at large)

The identified needs (as outlined below) have been used to shape the mandate of NOBI. These critical needs were identified and developed through the participation of the NOBI Steering Committee which includes representation of the local biotechnology SMEs, economic development organizations, academics and scientists.

#### 3.5.1 Industry Needs

Several needs pertaining to the local industries have been identified and are listed in the table below, with possible solutions that could be provided through a Regional Innovation Network (RIN). Organizations with these needs in Northern Ontario include NEUREKA, Genesis Genomics and Mikro-Tek, as well as SMEs and MNEs in the traditional sectors of forestry and mining. NOBI will be developed to address these needs of the local industry.

Industry's Needs	Proposed Solution
Assistance with technology adoption	<ul style="list-style-type: none"> <li>• Dedicated support to assist with bringing in new technologies</li> </ul>
Partnership and opportunity evaluation	<ul style="list-style-type: none"> <li>• Strategic analysis and support to identify potential partnerships and opportunities</li> </ul>
Linkage to research infrastructure	<ul style="list-style-type: none"> <li>• Support and advocacy to build relationships with regional research assets for contract research</li> </ul>
Highly qualified personnel (HQPs)	<ul style="list-style-type: none"> <li>• Employee networking, training and attraction to the region (recruit and retain)</li> </ul>
Out-licensing	<ul style="list-style-type: none"> <li>• Assistance with finding and facilitating partnership and out-licensing opportunities</li> </ul>
Promoting/marketing benefits of local research	<ul style="list-style-type: none"> <li>• Outreach and marketing to communicate the advantages of technology adoption and the application of local research innovation</li> </ul>
Industry attraction	<ul style="list-style-type: none"> <li>• Outreach and marketing to promote Northern Ontario</li> </ul>

#### 3.5.2 Research Needs

It is recognized that the regional research assets (academic, public, not-for-profit and private) are key to the growth of biotechnology within a region. Therefore, in addition to the local industry, the needs of the research community are also a consideration in the development of a Regional Innovation Network (RIN). In particular, the new Northern Ontario Medical School (NOMS) will be a key research organization that NOBI will be looking to support. The highest priority needs are listed in the table below.

Research Needs	Proposed Solution
Increased support for research	<ul style="list-style-type: none"> <li>• Advocate for increased funding and support for research in Northern Ontario</li> <li>• Assist in the acquisition of research funding</li> </ul>
Star attraction	<ul style="list-style-type: none"> <li>• Attraction of HQP to the region</li> </ul>
Connections to industry	<ul style="list-style-type: none"> <li>• Assist in the development of productive linkages between research and industry</li> </ul>
Technology transfer	<ul style="list-style-type: none"> <li>• Expand the local technology transfer expertise and capacity</li> </ul>
Commercialization assistance	<ul style="list-style-type: none"> <li>• Increase the incubation facilities and assistance for spin-outs and start-ups</li> </ul>

### 3.5.3 Other Needs

In addition to the needs of the research and industrial stakeholders, several other needs have been identified that broadly apply to the pan-Northern stakeholders. These needs are particularly important to the economic development offices and municipal governments of each of the communities, as well as to the general public. These needs are listed in the table below.

Other Needs	Proposed Solution
Community outreach and awareness	<ul style="list-style-type: none"> <li>• Generate a greater acceptance and interest in local biotechnology initiatives</li> </ul>
Branding and marketing	<ul style="list-style-type: none"> <li>• A single voice to engage in external promotion of the region to attract investment, SMEs, partnerships, HQP, etc.</li> <li>• Provide a global address</li> </ul>
Lobbying and advocacy	<ul style="list-style-type: none"> <li>• A single voice to increase support and investment in the region</li> </ul>
Awareness of potential funding sources and current priorities	<ul style="list-style-type: none"> <li>• A resource that provides current information on various funding programs and opportunities</li> </ul>

### 3.6 Mandate

With the stated, regional needs in mind, a preliminary mandate has been developed for NOBI. The mandate will help shape and define the core values of this regional network.

A draft version of the mandate is proposed:

*NOBI will promote the adoption and commercialization of biotechnology in Northern Ontario by facilitating and promoting collaborative partnerships that create a two-way flow of knowledge and opportunities between industry and research.*

### 3.7 Programs & Services

Several programs and services have been proposed to assist the growth of Northern Ontario's biotechnology communities. The programs and services offered by NOBI can be categorized into two main activities described below: outreach and commercialization.

These services will be available through the Executive Director and specialist resources that will be provided via the Network. It is essential to NOBI that these services are broadly available across Northern Ontario and that the specialist resources seek to leverage existing local community representation, including economic development offices, the Industrial Research Assistance Program (IRAP), FedNor and the Ministry of Northern Development and Mines (MNDM), as a first point-of-contact for referral to the Network specialists. The priorities for the delivery of programs and services will be as determined by the Board of Directors, and efforts will be directed towards those activities with the greatest potential for economic growth and job creation. Priority setting will not be directed by distance of travel or expense.

#### 3.7.1 Outreach

The outreach services of NOBI will encompass a series of networking functions to build synergies among the existing research assets of the region and to facilitate the creation of internal and external partnerships. While many of these services will be offered in-person through the Executive Director and sector specialists, NOBI will also take advantage of virtual communication methods, such as teleconferencing and electronic mail.

NOBI will undertake marketing and branding activities on behalf of Northern Ontario's biotechnology stakeholders. In this capacity, the NOBI specialists will become the central voice and a global address for attracting life sciences opportunities and investments to Northern Ontario. This marketing role would also include maintaining an up-to-date profile of the regional universities and colleges, research organizations and various industries that are associated with biotechnology.

NOBI will be a public voice for Northern Ontario's biotechnology industry by:

- Representing the region's biotechnology interests provincially, nationally and internationally.
- Providing reliable and timely information to promote the life sciences locally and externally.
- Enhancing the business climate for its members in order to help build life science companies in Northern Ontario and to make the region more globally competitive.

An important focus of the outreach and marketing strategies will be the development of an Internet presence that will become a key resource for the region. This web-based environment will also provide an important network for maintaining internal connectivity across the large distances in Northern Ontario. The NOBI website could include elements such as:

- Information on community events involving science and technology.
- A web accessible database allowing for increased connectivity between the regional research organizations and industry.
- Employment information, such as regional employment offerings, and other knowledge sharing programs, such as training and professional development opportunities.
- A general newsletter and public education component.

**Case Study:** UCSD CONNECT is a globally recognized, university-based public benefits organization that fosters entrepreneurship in the San Diego region by catalyzing, accelerating, and supporting the growth of the most promising technology and life sciences businesses. The organization was founded in 1985 at the urging of San Diego's business community, and it is widely regarded as a successful regional program linking high-technology and life science entrepreneurs with the resources they need for success: technology, money, markets, management, partners, and support services. CONNECT's services are tailored to meet the varying needs of San Diego entrepreneurs and these programs serve as a catalyst for the development and exchange of ideas, a forum to explore new business avenues and partnerships, and an opportunity to network with peers. Because of its success, the CONNECT model has been replicated in other cities and countries, including Scotland, Denmark, Norway, and Sweden.

### 3.7.2 Commercialization Support

The commercialization support services of NOBI will be designed to assist both established (MNEs) and nascent/growing (SMEs) companies. NOBI will assist companies to identify and adopt emerging technologies both from local and non-local research institutes that can be applied locally. Another important business service of NOBI will be to assist and support the formation of new companies (spin-offs), including assisting with intellectual property. Emerging and established companies will benefit from NOBI's business and strategic planning services and support for capital sourcing activities.

NOBI will look to leveraging those already existing organizations in the provision of commercialization support programs and services. For example, the Northern Centre for Biotechnology and Clinical Research's (NEUREKA!) expertise in proof-of-concept work and clinical research will be leveraged. The expertise of the university business development/technology transfer offices will be leveraged in support of intellectual property assistance. The Upper Lakes Environmental Research Network's (ULERN)

expertise in capital sourcing for industry will be leveraged through the NOBI Network as will Scienceworks' expertise in moving biotechnology products to market.

NOBI will catalyze cross-institutional and cross-industry opportunities for the bundling together of technologies in order to create new innovative industry approaches to problems and to increase technology transfer activity in Northern Ontario.

**Case Study:** The Northern Centre for Biotechnology and Clinical Research (NEUREKA!) is one of the customers whose needs will be served by NOBI. While NOBI will work with NEUREKA to offer services to other companies throughout Northern Ontario, particularly in the areas of clinical research and product-to-market initiatives, NOBI will also help NEUREKA! to achieve their organizational goals. NOBI will help NEUREKA! attain a higher profile in the Province, nationally and internationally by promoting their organization through informal and formal networking. NOBI will serve as an advocate for NEUREKA! provincially and internationally to help identify new business opportunities. NEUREKA! will be able to take advantage of the programs offered through NOBI including programs to attract HQP to the organization and opportunities for staff professional development. The sector specialists will be able to provide valuable advice and direction to NEUREKA! in the areas of capital sourcing, as well as providing referrals to experts in intellectual property and venture capital.

## 3.8 Operational and Organizational Structure

### 3.8.1 Operational Overview

#### **Incorporation of a Not-for-Profit Entity: NOBI**

NOBI will be created as a not-for-profit Regional Innovation Network (RIN) for Northern Ontario. The current NOBI organization will be incorporated and obtain not-for-profit status in order to transform itself into NOBI.

Northern Ontario is uniquely challenged by its vast geography necessitating strong community linkages and established networks. One of the core functions of NOBI will be to increase the connectivity between communities and the regional stakeholders (i.e. industry, academia, public research labs, EDOs, etc.). NOBI will also be an important conduit to link Northern Ontario to other biotechnology initiatives in Ontario, Canada and the world.

#### **Strong Relationship with MaRS Discovery District**

MaRS Discovery District will support the development and commercialization of biotechnology in Ontario. MaRS is designed to become a convergence centre to promote the commercialization of life sciences research. MaRS will create a highly networked community of scientists, entrepreneurs, spin-off companies, MNEs, venture capital organizations and others with the common goal of bringing innovation to the marketplace. In other words, MaRS will become the "one-stop-shop" for Ontario's biotechnology communities. With its impressive scope and scale, MaRS is envisioned to be Ontario's global address for the biotechnology industries. As the first phase of the MaRS infrastructure nears operational readiness, an aggressive international marketing campaign will be initiated. In addition to conducting this marketing blitz at prominent biotechnology conferences and events (i.e. BIO), MaRS is continuing to establish its

web-based presence and Internet outreach that will serve as single point-of-entry for companies and individuals looking to access Ontario's biotechnology industry.

MaRS is clearly an important asset that can be leveraged by Northern Ontario to assist with marketing and outreach. MaRS can be viewed as a gateway to a network of opportunities. In many respects, MaRS is a direct link for Northern Ontario to tap into the rest of the province, and other national and international opportunities. NOBI is therefore proposed to include extensive linkages and associations with MaRS.

The development of the linkage between Northern and Southern Ontario's biotechnology communities through NOBI will provide a two-way flow of information and benefits. The biotechnology communities of Northern Ontario will be able to access the services and networking opportunities provided by MaRS and also benefit from the increased international exposure and marketing.

The Executive Director of NOBI is proposed to be located at the MaRS Discovery District site in Toronto. In addition to providing a physical presence at the MaRS Discovery District development, this individual would be responsible for coordinating NOBI's marketing, networking, and operational strategies. The NOBI office, located in Toronto, would be designated as the central point of contact for provincial, national and international business development. This NOBI office would also serve a knowledgeable resource centre to promote the assets and opportunities in Northern Ontario.

#### **Creation of Sector Specialists Serving Northern Ontario**

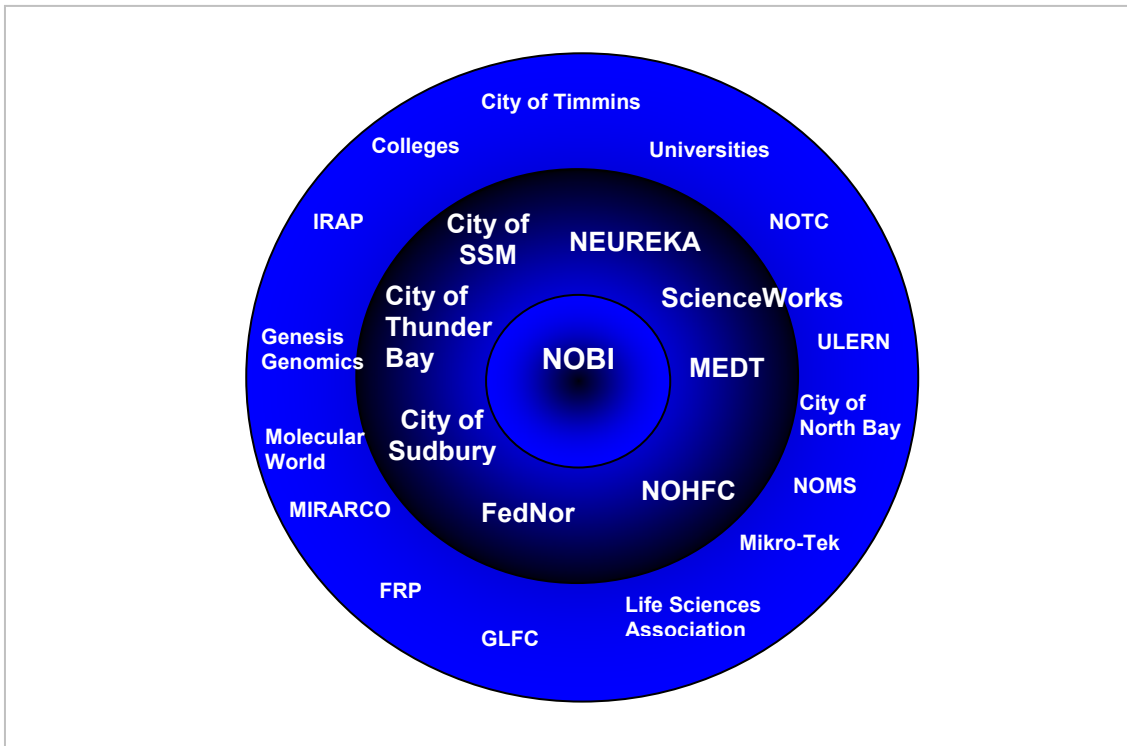
In order to best meet the needs of each of Northern Ontario's main industry sectors capable of utilizing biotechnology, three areas of industry specialization have been created as part of NOBI: bioproducts, environment and biomedical. Representatives with a broad knowledge of Northern Ontario, as well as sector specific knowledge, will be recruited in each of these areas of specialization. Each of these individuals will be located in a community with a concentration of both research and industry related to the area of specialization, however they will be responsible for providing services and representing their sector for the entire pan-Northern region. As demand for the services of these individuals is required throughout Northern Ontario, these individuals will travel to meet with stakeholders across the north and will also extensively take advantage of teleconferencing and electronic mail. Within each community, these specialists will maintain an extensive network of contacts with local organizations, such as economic development offices and the Industrial Research Assistance Program (IRAP) representatives.

**Leveraging the Resources that Currently Exist**

The success of NOBI will depend heavily on the level of community involvement and commitment, and therefore NOBI will leverage and network together those biotechnology assets that currently exist within Northern Ontario. The following diagram illustrates NOBI surrounded by those organizations who it is proposed will directly contribute resources, either cash or in-kind, to the operation of the Network. These contributing organizations are in turn surrounded by all of the biotechnology stakeholders in Northern Ontario who will access the network's programs and services. The entire circle diagram represents the network of organizations, institutions and companies that will be brought together into a broad biotechnology network through NOBI.

**Case Study:** NOBI will work together with the National Research Council's Industrial Research Assistance Program (NRC-IRAP) to mutually achieve their goals of providing innovation assistance program for small and medium-sized (SMEs). IRAP currently has eight positions for Industrial Technology Advisors (ITAs) located throughout Northern Ontario who provide a local presence and are very knowledgeable about innovation activities within their communities. The sector specialists of NOBI will work closely with the ITAs to keep up-to-date on local innovation and as a specialized resource for the ITAs to utilize with their biotechnology clients.

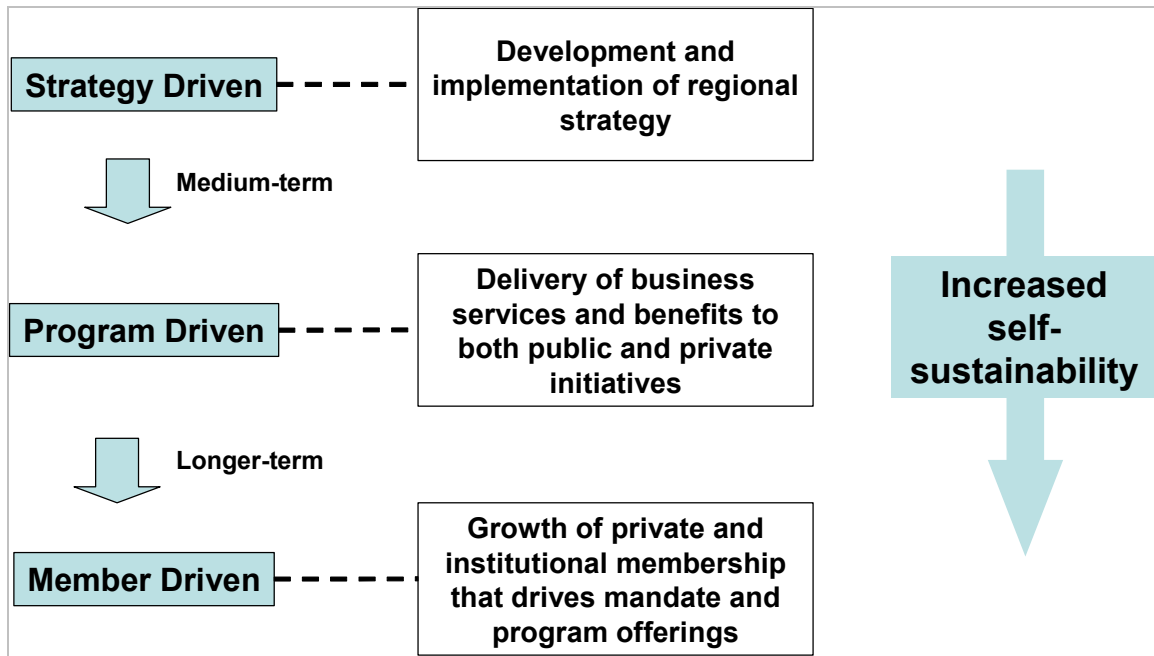
NOBI is a collaboration among the stakeholders. As NOBI becomes established and illustrates its tremendous value to the Northern Ontario biotechnology community there is an opportunity for the partners to increase their role and assist with program delivery.





**Moving from Strategy-Driven to Self-Sustainability**

NOBI will initially be a strategy organization with a focus on economic development and developing strategic initiatives and directions to address the unique challenges and opportunities in Northern Ontario. Given the small number of biotechnology companies and initiatives currently operating in Northern Ontario a strategy-driven model will have the greatest impact within the shortest timeframe. In this regard, one of the initial focuses of NOBI will be on the growth of the biotechnology sector and, consequently, on job creation. As the shift from a strategic organization to a program-driven organization continues, the Network will increasingly attract members and can begin to offer fee-for-service programs. As the programs offered by NOBI are increasingly developed, the organization will strive to build its membership of individuals, SMEs, MNEs and various public, academic and not-for-profit research organizations. The provision of valuable services by NOBI will be the driving factor in recruiting a robust membership throughout the region. The membership will then begin to guide the mandate and programming of NOBI which will ensure that the offered services and programs continually meet the evolving needs of the local biotechnology communities. Over time, NOBI will increasingly become a member-driven organization and therefore able to generate revenue through both membership fees and fee-for-service arrangements. As a member-driven organization, NOBI will represent small biotechnology companies, large corporations, universities, colleges, and service providers who share the goal of making Northern Ontario a centre for the development and commercialization of biotechnology.



### **Looking to the Future**

Northern Ontario is poised through NOBI to develop an integrated and collaborative approach to growing the knowledge-based economy. The established industries of forestry and mining are accepting biotechnology as a new way to ensure future global competitiveness. The Northern Ontario Medical School (NOMS) will help to draw medical researchers to Northern Ontario and help to seed new and innovative research with potential for commercialization.

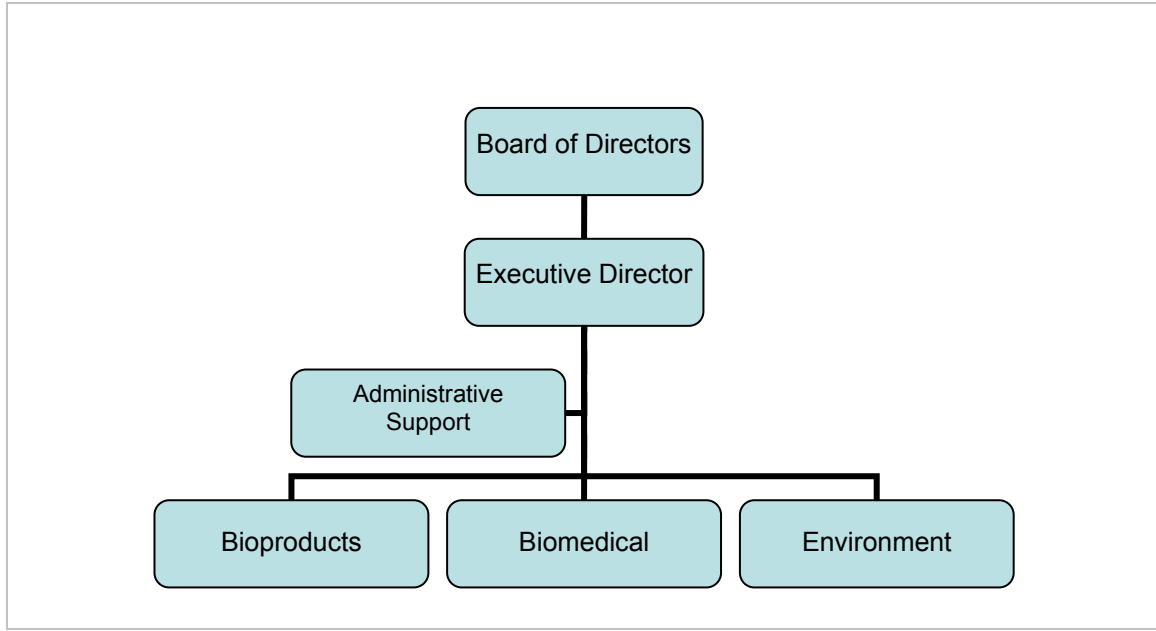
The foundation organization established in NOBI over the next 4 years has the potential to expand into a much larger organization offering a broad range of products and services to the growing Northern biotechnology communities. As demand for the services of the sector specialists increases, one can see a future where there are additional specialists throughout Northern Ontario providing broader permanent representation to each of the communities. The future will also allow for expansion of the technology transfer and commercialization services that are available through the Northern universities and available to the broader community.

#### **3.8.2 Organizational Model**

The roles and responsibilities of each of the employees of the NOBI organization are outlined below, and the organizational chart diagrammed below illustrates the proposed reporting relationships. The Executive Director provides the primary line of communication between the Board of Directors and the sector specialists, and oversees the activities of the Network as a whole.

While the sector specialists have been located in communities where there is a logical concentration of industry and research activity, they will have a mandate to ensure that their services are provided, as required, throughout Northern Ontario. In particular, it is essential that all businesses across Northern Ontario are served in an equitable fashion, and as such the performance metrics of the individuals and NOBI will be tied to this pan-Northern approach. Through partnership with local economic development offices and the Industrial Research Assistance Program (IRAP) representatives, combined with a significant travel budget, the sector specialists and the Executive Director will ensure that there is equitable service access across the North.

A first priority for expansion of the network beyond 2008 is to provide local specialists to the communities of North Bay and Timmins, who in the first phase of NOBI, will not have local NOBI representation. A second priority for 2008 and beyond is to consider the addition of new specialists to the communities of Thunder Bay, Sudbury and Sault Ste. Marie in those specialty areas where they will not have local representation in the initial phase of this Network.



### Executive Director

The Executive Director will be an important resource for NOBI and will be instrumental in establishing the necessary linkages and networking opportunities. It is proposed that the Executive Director have a primary office within MaRS Discovery District in Toronto, but that they travel extensively and regularly both throughout Northern Ontario to visit the sector specialists, as well as nationally and internationally in their outreach efforts. The Executive Director will be the first employee recruited to NOBI. A brief description of this role is included below.

#### Roles and responsibilities:

- Representing Northern Ontario on selected provincial, national and international business development opportunities and organizations
- Active marketing of Northern Ontario's assets and identification of opportunities and coordination of efforts for attracting new business opportunities to Northern Ontario
- Development of new programs to meet the needs of the business community of Northern Ontario
- Coordinating the activities of the Network including the day-to-day operations and management
- Developing and implementing the marketing, branding and strategic initiatives, as directed by the NOBI Board of Directors
- Facilitating knowledge management and flow, including coordinating the development of the Internet and other outreach initiatives
- Gathering information and maintaining an extensive and current inventory of regional innovation assets, strengths and the needs of the public and private institutions

Qualifications and experience:

- Knowledge of Northern Ontario and the existing networks and biotechnology assets
- Project management, communications, marketing and branding expertise
- Extensive business development experience, including networking and building strategic alliances

Success metrics for the performance of the Executive Director:

- Growth of regional businesses due to the marketing, networking and other efforts of NOBI
- HQP recruited to or retained within the region, in collaboration with partner institutions, industry and the communities
- Number of business and alliance opportunities identified via analysis of gathered information
- Deals, partnerships and investments secured due to the efforts of NOBI throughout Northern Ontario
- Additional metrics will also be utilized to measure success as they become available

Sector Specialists

The sector specialists are responsible for maintaining an up-to-date knowledge of assets and ongoing activities relating to their sector throughout Northern Ontario. They will provide expert knowledge and assistance to individuals and companies utilizing biotechnology. They will as necessary provide referrals to external resources for further information.

The sector specialists will undertake to further develop and obtain capital for initiatives identified within their area of specialization and as prioritized by the Executive Director and the Board of Directors.

Key skills for the sector specialists include:

- Understanding of economic environment, existing organizations and funding opportunities in Northern Ontario
- Sector specific knowledge, including post-secondary education and industry experience
- Networking, marketing and communication skills in interacting with a broad range of stakeholders
- Broad knowledge of commercialization processes, including intellectual property, technology assessment, licensing, company creation, market assessment, prototype development, capital sourcing, and business plan development
- Skills in project management and management of multiple concurrent responsibilities
- Willingness to travel extensively throughout Northern Ontario

*Bioproducts*

An individual dedicated to promoting bioproducts for Northern Ontario will be located in Sault Ste. Marie within ScienceWorks! (ScienceWorks! will be located with the Great Lakes Forestry Centre (GLFC) until such time as it acquires its own infrastructure). GLFC is willing to provide in-kind contributions of office space for this individual. Sault

Ste. Marie is an ideal location for the bioproducts specialist due to the local concentration of assets and organizations involved in bioproducts.

#### *Environment*

An individual dedicated to promoting the environment for Northern Ontario will be located in Sudbury at the Northern Centre for Biotechnology and Clinical Research (NEUREKA!). Sudbury is an ideal location for the environment specialist due to the concentration of mining and mining service companies in Sudbury and the ongoing initiatives in mining clustering.

#### *Biomedical*

An individual dedicated to promoting biomedical and health in Northern Ontario will be located in Thunder Bay at the Innovation Management Office of Lakehead University. Thunder Bay is an ideal location for the biomedical specialist due to the concentration of assets and organizations involved in medical biotechnology located within Thunder Bay.

### **3.8.3 Governance Model**

NOBI will maintain an active and experienced Board of Directors who will attract other prominent community individuals willing to contribute, provide knowledge, and other business resources. The Board of Directors will represent a variety of stakeholders, such as biotechnology SMEs and MNEs, academic and research institutions and economic development organizations. While initially the Board of Directors will be made up of the current representatives of the NOBI Steering Committee, as the shift from a strategy-driven to a program-driven occurs, the representation of economic development on the Board will decrease. Within four years, it is targeted that economic development will hold three seats on the Board of Directors, and the total Board will be reduced from 11 to 8 members. Tenure on the Board of Directors will be for a term of two years.

## **3.9 Success Metrics**





The successes of NOBI will be defined by specific milestones, these will include:

- Increased adoption and application of biotechnology by local industries
- Increased job creation and attraction of highly qualified people (HQP)
- Increased commercialization competitiveness (disclosures, licenses, start-ups, spin-offs)
- Greater number of partnerships and alliances between industry and academia both internally and with external partners
- Greater foundation of basic research infrastructure in Northern Ontario
- Regional branding that becomes recognized provincially, nationally and internationally
- A marketing effort that supports the attraction of companies and partnerships to the region

As the success of the Network increases and the demand for programs and services outstrips the capacity of the Network herein described, NOBI will expand to include additional sector specialists both to provide additional communities with local Network

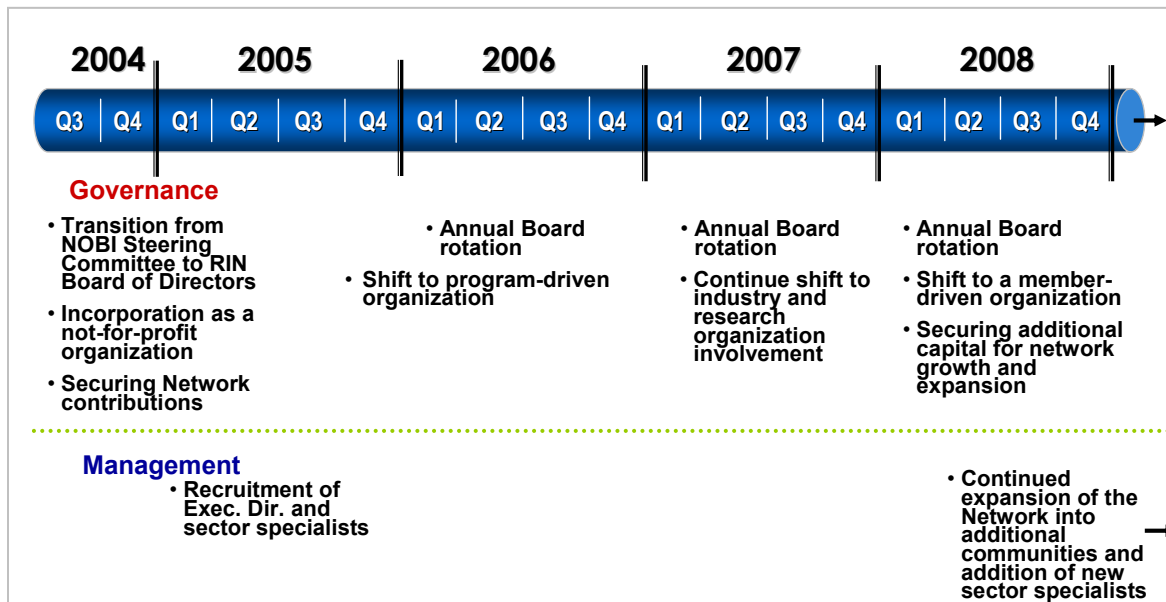
representation and to increase the areas of specialization available in the larger communities. Expansion of the Network will be a significant milestone for NOBI.

### 3.9.1 Impacts

	<p>Local Impact</p>		<p>Provincial Impact</p>
<ul style="list-style-type: none"> <li>• Increased industry liaison internally and externally</li> <li>• Economic growth and job creation</li> <li>• Increased research investment into Northern Ontario</li> <li>• Increased company creation activity, and attraction and retention of industry</li> </ul>		<ul style="list-style-type: none"> <li>• Improved intra-provincial networking</li> <li>• Renewal of traditional industries</li> <li>• Growth of the provincial biotechnology industry due to increased availability of funds</li> <li>• Model program that could be syndicated provincially</li> </ul>	
	<p>National Impact</p>		<p>Global Impact</p>
<ul style="list-style-type: none"> <li>• Growth of the biotechnology industry due to increased availability of funds</li> <li>• Model program that could be syndicated nationally</li> </ul>		<ul style="list-style-type: none"> <li>• Greater biotechnology innovation and competition</li> <li>• Increased global profile for Northern Ontario's research institutions</li> </ul>	

**Case Study:** The Life Sciences Greenhouse of Central Pennsylvania (LSGCP) is accelerating economic growth and job creation by promoting the commercialization of life sciences in the region, helping to transfer technologies, develop new companies, and providing sustainable jobs and economic growth to the region. A significant and focused funding effort has been successful in transforming the local biotechnology environment and in creating a cooperative technology transfer system allowing for a single point of industry contact and negotiation.

### 3.9.2 Timelines



### 3.9.3 Synergies and Partnerships

#### MaRS Discovery District

MaRS Discovery District is an important strategic partner for NOBI. Marketing and branding efforts will be coordinated with MaRS Discovery District to ensure continuity of messaging. The Executive Director, because of his/her location within MaRS Discovery District, will work closely with the current management of MaRS and the anticipated new commercialization staff. NOBI will work with MaRS to ensure that databases and portals created by the Network are incorporated into all Provincial initiatives.

#### Other Regional Innovation Networks

NOBI will also strive for close relationships with other Regional Innovation Networks emerging from the BCIP process. In particular, close relationships with Southwestern Ontario and Ottawa/Eastern Ontario will be fostered in the area of bioproducts and Guelph-Waterloo in the area of the environment.

#### Other Potential Resources

The following describes some of the resources throughout Northern Ontario that will be leveraged and utilized as part of the NOBI Network.

*Industrial Research Assistance Program (IRAP)*

There are currently eight Industrial Research Assistance Program (IRAP) positions located throughout Northern Ontario. These individuals are a key source of local knowledge and will be an asset that NOBI will look to leverage to ensure local knowledge and presence. NOBI will work to establish strong relationships with the IRAP representatives.

*Economic Development Offices*

The Economic Development Offices throughout Northern Ontario, and in particular in the five major centres, will be important partners in NOBI. These offices, in addition to being represented on the NOBI Board of Directors, will contribute in-kind services by the referral of individuals, organizations and companies to the appropriate NOBI sector specialist for access to programs and services.

Other Potential Funding Agencies

*FedNor*

A potential federal government funding source for NOBI that will be explored is FedNor. FedNor has three regions that will be part of NOBI and therefore funding for this Network will require collaboration among these regions. FedNor has an interest in funding biotechnology within its commitment to increase the overall competitive position of the North and to accelerate its movement to a knowledge-based economy.

*The Northern Ontario Heritage Fund (NOHFC)*

The NOHFC is a potential source of provincial government funding for NOBI. The NOHFC works in partnership with the private sector and other levels of government to diversify and grow the Northern economy and stimulate jobs, and as such the NOBI initiative is likely to fall within its mandate.

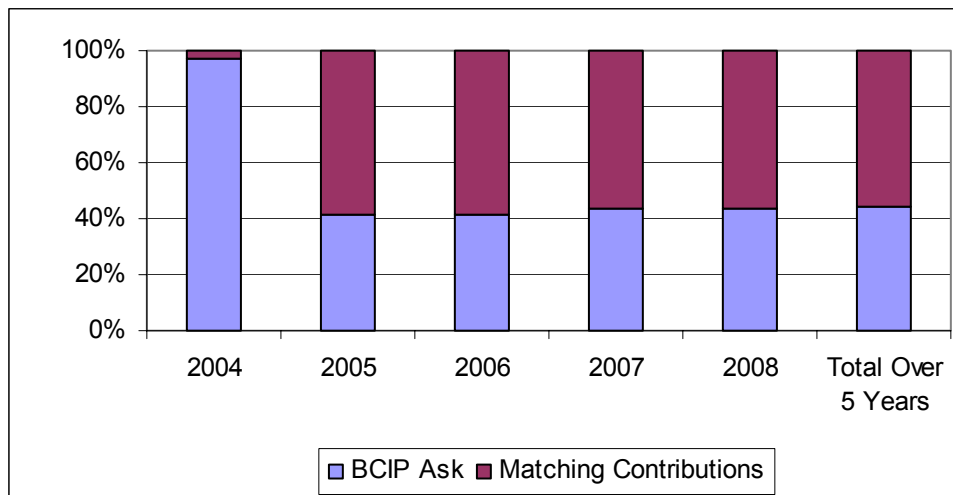


## 3.10 Financial Highlights

### 3.10.1 Summary of Expenses

	2004	2005	2006	2007	2008	Total Over 5 Years
<b>Expenses</b>						
Salaries & Benefits	\$ 25,000	\$ 365,000	\$ 375,950	\$ 410,706	\$ 423,027	\$ 1,599,683
Administration Costs	\$ -	\$ 173,000	\$ 174,110	\$ 185,253	\$ 186,431	\$ 718,794
Board of Director Costs	\$ 49,500	\$ 93,000	\$ 85,150	\$ 77,305	\$ 69,464	\$ 374,418
Contingency allowance	\$ 3,725	\$ 31,550	\$ 31,761	\$ 33,663	\$ 33,946	\$ 134,645
<b>Total Expenses</b>	<b>\$ 78,225</b>	<b>\$ 662,550</b>	<b>\$ 666,971</b>	<b>\$ 706,927</b>	<b>\$ 712,868</b>	<b>\$ 2,827,540</b>

### 3.10.2 Summary of Revenues Sources



### 3.10.3 Investment Request

	2004	2005	2006	2007	2008	Total Over 5 Years
<b>BCIP Ask</b>	\$ 75,725	\$ 249,383	\$ 248,284	\$ 282,555	\$ 282,639	\$ 1,138,586
Matching Contributions	\$ 2,500	\$ 413,167	\$ 418,687	\$ 424,372	\$ 430,228	\$ 1,688,954

### 3.10.4 Sustainability

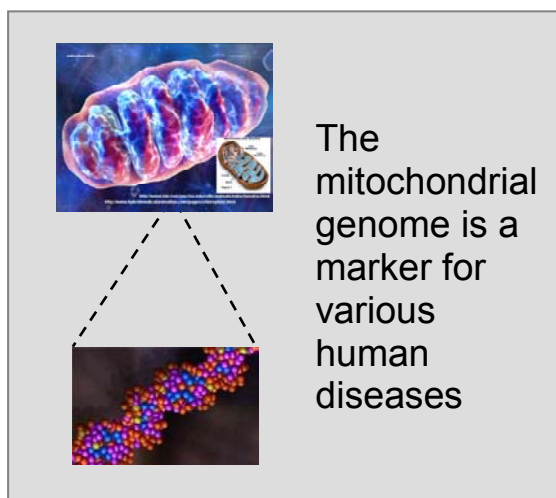
As NOBI establishes its programs and their value to the community, it is anticipated that a model of sustainability will be established. Revenues could be obtained from other Provincial and Federal government funding programs, as well as through the collection of program fees from company and institutions.

## 3.11 Introduction to Business Concepts

### 3.11.1 The Genomics-North Initiative

#### Overview

As biomedical research continues into the post-genomics era, studies continue to unravel the complex relationships between the human genome and various diseases. Work in this field is beginning to uncover various genetic markers that may indicate a predisposition to disease, a positive response to a particular medical therapy, or even an increased risk following exposure to certain environmental toxins. This business case outlines the development of the Genomics-North Initiative which links DNA-based research to public health. The proposed project is built out of three key strengths in the genomics sector that are located in Northern Ontario:



1. The genomics infrastructure and world-class expertise in mitochondrial DNA (mtDNA) (Thunder Bay)
2. Clinical and genomics expertise pertaining to increased cancer-risks following exposure to environmental toxins (Sudbury)
3. The largest primary care disease site registry in Canada consisting of 58,000 patients (Group Health Centre, Sault Ste. Marie)<sup>69</sup>

This business plan integrates these significant assets to form a valuable resource for medical researchers throughout the Province, the Nation and the World. This genomics initiative includes the development of a database for mtDNA sequence variations and will correlate this information to clinical findings. The proposed database will form one of the most comprehensive mtDNA surveys performed to date and will be called MitoNorth.

<sup>69</sup> Personal communication, Greg Punch, Group Health Centre

## **Background**

Clinical genomics is a field of study that attempts to identify genetic sequence variations that can serve as both markers for disease susceptibility and/or as causal factors in the development of disease. Traditional DNA genetic linkage analysis which is typically based on nuclear DNA (i.e. the complete human genomic sequence of over 3 billion basepairs) has been applied successfully to locate several genetic mutations related to specific diseases. However, these methods have demonstrated much less success with common diseases that may have several contributing factors (i.e. complex diseases) such as diabetes, heart disease and cancer. Much less work has been performed to define associations between the mitochondrial genome and human diseases. The mitochondrial genome is an excellent tool for genomics studies on complex diseases as it very small (approximately 16,000 bases) as compared to the nuclear genome making it an attractive option to construct an extensive database involving thousands of individuals. Initial studies have indicated that the mitochondrial genome has a strong association with several human diseases and aging. In fact, well over 150 diseases have been linked to mutations in the mitochondrial genome. A listing of diseases caused by mutations to the mitochondrial genome has been reported by the Mitochondrial Research Society<sup>70</sup>, a nonprofit international organization of scientists and physicians.

Research on the mitochondrial genome and its uses as a marker for human health and disease is a unique and promising opportunity for Northern Ontario for two reasons:

1. Mitochondrial medicine is a niche area of research and the commercial opportunities have yet to fully develop.
2. Northern Ontario currently has the research assets and potential to establish a prominent role within this emerging sector.

Currently there are no comprehensive databases for mtDNA sequence information available to the medical research community. For instance, though there are numerous partial sequences, there are only 707 entries in Genbank for complete human mtDNA sequences<sup>71</sup>. There are databases compiled by a few organizations such as Genesis Genomics, Mitokor, the FBI and the publicly available, Mitomap<sup>72</sup>. Mitomap does contain some sequence information linked to clinical information, but overall the number of samples in these databases are limiting in terms of drawing reliable statistical conclusions for the purposes of disease association and for human identification. This proposal of the Genomics-North Initiative is to establish the MitoNorth database and to conduct initial population based studies relating mtDNA sequence information to clinical findings. This multidisciplinary effort envisions significant collaboration and partnership with the existing databases noted above. In particular, it is anticipated that MitoNorth could be developed in parallel with MitoMap, using complementary data formatting and programming models to ensure the potential for future integration. The commercial applications of the MitoNorth database are far reaching, the opportunities include:

- Diagnostic applications – the database will permit the identification of sequence variations that can be used to predict susceptibility to certain diseases.

---

<sup>70</sup> <http://www.mitoresearch.org/>

<sup>71</sup> [http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Search&db=Nucleotide&term=Homo\[Organism\]+AND+mitochondri\\*\[Title\]+AND+16000:17000\[SLEN\]+NOT+partial\[All+Fields\]+NOT+EST\[keyword\]&dispmax=100&doptcmd=DocSum](http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Search&db=Nucleotide&term=Homo[Organism]+AND+mitochondri*[Title]+AND+16000:17000[SLEN]+NOT+partial[All+Fields]+NOT+EST[keyword]&dispmax=100&doptcmd=DocSum)

<sup>72</sup> Wallace, D. C. and Lott, M. T. "MITOMAP: A Human Mitochondrial Genome Database" <http://www.mitomap.org>, 2004.

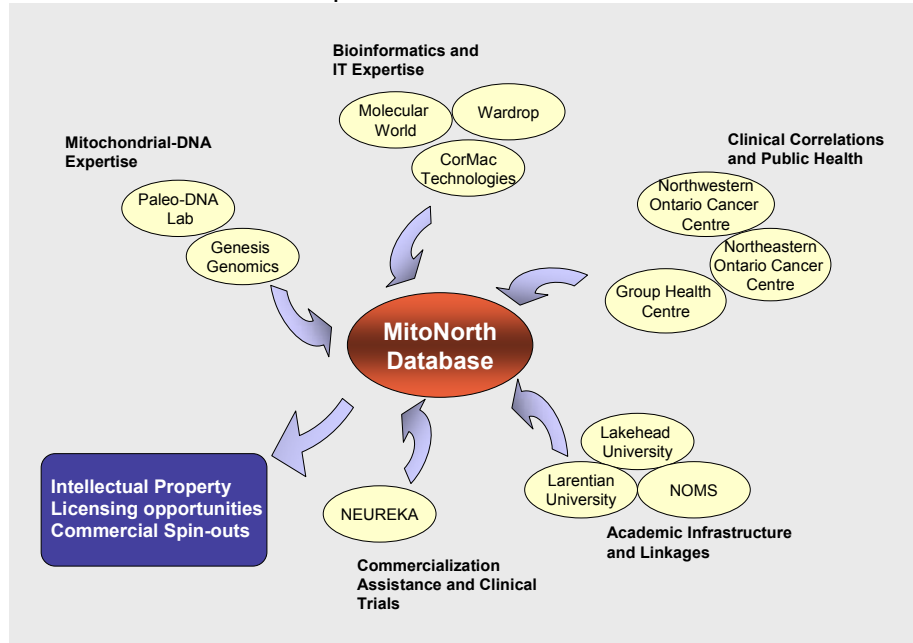
Biotechnology and diagnostic companies can mine the database to identify diagnostic markers for a variety of diseases.

- Drug target identification – pharmaceutical companies, such as Pfizer and GlaxoSmithKline, have active discovery programs in disease areas related to mitochondrial-associated diseases (i.e. neurodegenerative diseases and others).
- Pharmacogenomics – the database may identify polymorphic markers (i.e. single nucleotide polymorphisms, or SNPs) that can be used to predict an individual's response to drug treatment.
- Forensics – mtDNA has proven to be an extremely useful forensics tool and its uses in this field are far reaching. For instance, mtDNA is present at much higher levels than nuclear DNA and can be used when sample size is limiting. The database will be valuable to several companies and organizations interested in forensics applications, such as:
  - Human Identification companies, such as Molecular World Inc., can access the database for paternity, forensic, ethnicity and relationship testing services.
  - Institutions (Paleo-DNA Laboratory, Lakehead University, museums) and companies with an interest in ancient DNA that can be used for studying ancient disease studies and genealogy.
  - Federal police services (RCMP) and provincial police services such as the Centre for Forensic Science (CFS) for solving crimes especially pending cold cases. The database could house a specialized sub-database that would be a secure, restricted access, national repository for criminology purposes.
  - Foreign governments and organizations (i.e. the United Nations) that need access to specialized forensics services and databases that can be used to identify people following mass disasters. Examples could include the forensics work that was required following the 9/11 disaster or other humanitarian projects that may result from armed conflicts (i.e. the human identification work that was performed in East Timor and the former Yugoslavia).
- Environmental toxicology and public health studies – The Northeastern Ontario Regional Cancer Centre is currently studying the exposure of miners to industrial toxins and potential linkages to cancer risks<sup>73</sup>. Importantly, this research is also collecting genomics information on the study group. These studies will attempt to identify individuals that may have a genetic susceptibility to environmental toxins. This research has important implications to public health and the environment. This genomics information will be a valuable asset to the Genomics-North Initiative. Currently, mitochondrial sequence data is not being collected for these individuals but such data would be a valuable addition to the MitoNorth database.

---

<sup>73</sup> Consultation, Dr. A. Parissenti, Research Scientist, Northeastern Cancer Centre

The MitoNorth database will become an important commercial asset. It will be inclusive of all groups within Northern Ontario. To this end, every effort would be made to include First Nations peoples to generate the only database in the world focusing on aboriginal health from a mitochondrial DNA perspective.



The Northern Ontario Medical School (NOMS) working with the First Nations communities could play a major role in making this a reality. The correlation of genomic data linked to diseases common to First Nations peoples (such as diabetes) would be an important focus of the database.

**Regional and Biotechnology Assets to be Leveraged**

Northern Ontario possesses several key and somewhat under-recognized strengths in genomics (both nuclear and mitochondrial) and in clinical research. If combined, these assets will create a unique tool for biomedical research studies. Specific examples that can be directly applied to this initiative are highlighted:

1. Regional strengths in mitochondrial DNA research (Genesis Genomics, Molecular World, Paleo-DNA Laboratory at Lakehead University). There are currently more than 20 PhDs working on mitochondrial genetics located in Thunder Bay.
2. The existing base of biotechnology companies in genomics research (i.e. Genesis Genomics Inc., Molecular World, Cormac Technologies and Wardrop). Many of these companies are currently researching the mitochondrial genome from a variety of perspectives and provide a foundation of technical support staff and expertise.
3. Northern Ontario’s network of medical research institutes (NOMS, Lakehead University Paleo-DNA Laboratory, the Northwestern Ontario Regional Cancer Centre, the Northeastern Ontario Regional Cancer Centre and NEUREKA!).
4. Commercialization and technology transfer expertise pertaining to both clinical and biotechnology research (NEUREKA!, Lakehead University, Laurentian University).
5. The largest patient database, 58,000 medical records, is stored and tracked electronically at the Group Health Centre in Sault Ste. Marie.
6. Existing information technology infrastructure (i.e. the CRAY computer at Lakehead University and the ORION network).
7. Existing research partnerships throughout Ontario (i.e. Genesis Genomics has links to The Hospital for Sick Children and McMaster University).

### **Business Concept**

The Genomics-North Initiative is a far reaching initiative that builds on many of the research assets within Ontario. The initiative will have important scientific and economic benefits to the region, these include:

1. Facilitating collaboration among mitochondrial scientists around the Province, such as those located at:
  - Lakehead University
  - Northern Ontario's biotechnology companies
  - University of Toronto
  - McMaster University
  - Peterborough DNA initiative
2. Creation of bioinformatics resources in Northern Ontario
3. Stimulus for new job creation in Ontario's biomedical industry
4. Collaboration among federal and provincial police services through their DNA testing laboratories. For instance, the Head of the RCMP DNA Database has expressed genuine interest in this project<sup>74</sup>. Private DNA companies interested in human identification could also become collaborators.

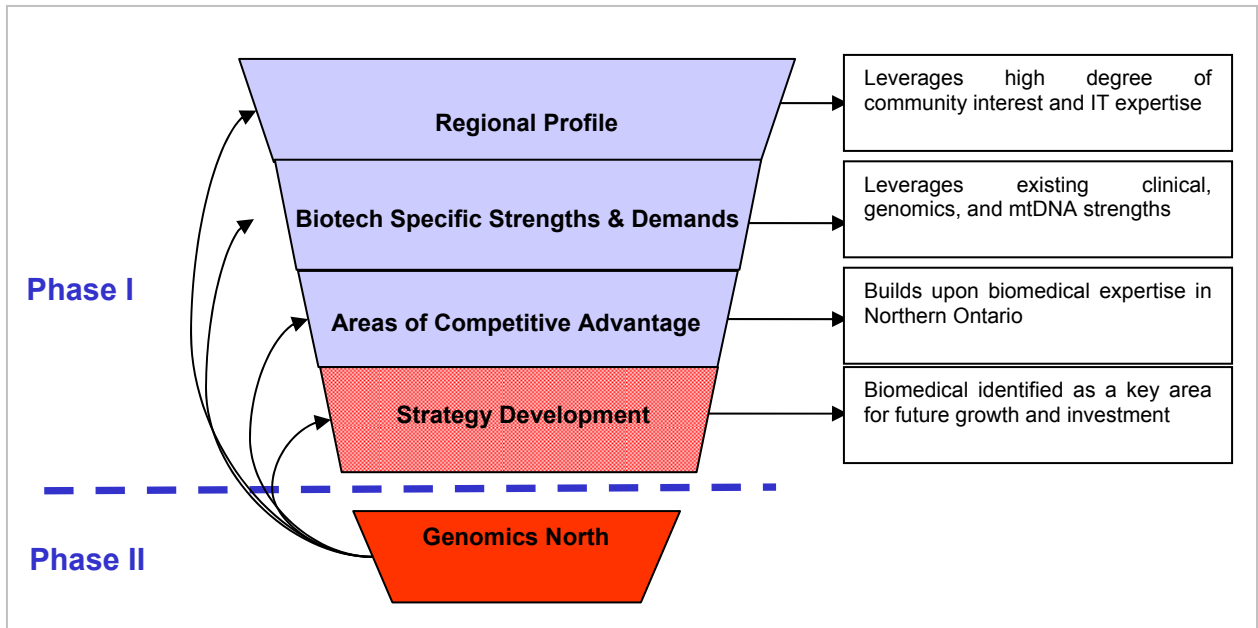
The Genomics-North Initiative combines several assets located throughout Northern Ontario. In the start-up phases, this initiative will actively seek collaborations and partnerships with existing databases (i.e. the Biomolecular Interaction Network Database (BIND)) and various research and clinical assets located throughout the Province. NOBI will be a fundamental asset that can promote and facilitate the development of these linkages.

MitoNorth would be the only large scale mitochondrial database resource in Canada. It would provide a service for researchers around the globe and would greatly enhance the niche position of the Province, and especially Northern Ontario, in mitochondrial-associated disease and identification.

This business model is to develop a research-based project that will help existing public and private biomedical organizations grow in Northern Ontario. This initiative will continue to expand in both size and scope as it gains international recognition. Once established, this initiative will spawn potential commercial opportunities and ongoing revenue streams.

---

<sup>74</sup> Personal communication, Dr. A. Chahal, Molecular World Inc.



**Case Study:** The Blueprint Initiative is a public research program of the Samuel Lunenfeld Research Institute at Mount Sinai Hospital and is affiliated with the University of Toronto. A major task of the Blueprint Initiative is the development of the Biomolecular Interaction Network Database (BIND). BIND is a proteomics database with descriptions of molecular interactions, complexes and pathways. The Development of BIND is an excellent model for MitoNorth, as they are both research initiatives to develop a public database that will be of interest to industry. One of the goals of both initiatives is to identify and develop commercial opportunities following the creation of a database.

BIND has been supported by both public and private organizations. Public sector sponsorship includes:

- Genome Canada (\$12.5 M from April 2002 - 2005)
- The Ontario Research and Development Challenge Fund (\$5.39 M)
- The CIHR (\$0.36 M in seed funding followed by \$1.0 M)
- NSERC (\$105,000)

Private sector contributions include:

- Sun Microsystems of Canada Inc.
- Foundry Networks Inc.

Blueprint has also been historically supported by:

- Canadian Foundation for Innovation (\$1.4 M)
- MDS Proteomics Inc.
- MDS Sciex
- IBM
- Intel
- Platform Computing

### Steps to Move Forward

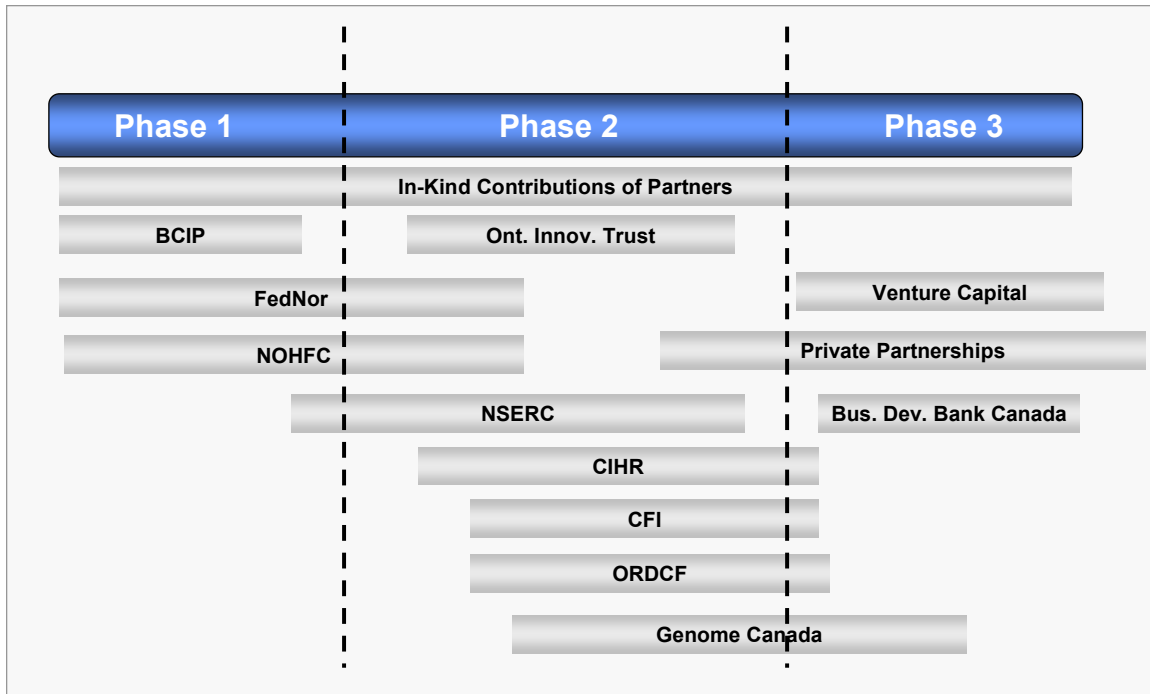
The development of a comprehensive genomics database is a long-term initiative that will encompass several stages. Three major stages have been outlined below:

#### Step 1 – Tool Development

This phase will primarily include leveraging the existing regional assets and expertise. The main objectives of this phase include tools and software assets to support a database, sample collection and sequencing, and data input (including the associated clinical information). These objectives will be met through the following steps:

- *Partnership development and capital sourcing* – The various partner organizations have been identified (see below) and the first step will be to formally develop partnership and collaborative agreements (i.e. MOUs). In this capacity, the proposed database will serve as an important link that will increase the cooperation and collaboration among the various research and health institutions in Northern Ontario and the rest of Province.
  - Genesis Genomics Inc. – Commit bioinformatics specialists to assist in data-mining and database design. Also, Genesis Genomics will recruit and acquire patient samples through their cancer research program.
  - Molecular World Inc. – Conduct sequencing of modern samples at cost, which is anticipated to be approximately \$2,000 Cdn per genome.
  - Paleo-DNA Laboratory - Could conduct sequencing of ancient samples, as needed, at cost, which is anticipated to be approximately \$2,000 Cdn per genome.
  - NEUREKA! – Assist in developing ethical policy and external review of policies and guidelines. NEUREKA! could assist in recruiting specific patient populations and could participate in clinical trials for commercial outcomes (i.e. medical diagnostic tests).
  - Northeastern Ontario Regional Cancer Centre – Contribute expertise in nuclear genomics and studies pertaining to environmental toxicity, and participation in patient recruitment.
  - Group Health Centre – Mining of patient database in an effort to identify potential clinical samples of interest. Recruiting specific patient populations and leading clinical trials for commercial outcomes.
  - Northwestern Ontario Regional Cancer Centre – Participation in patient recruitment.
  - The Ontario Ministry of Economic Development and Trade (MEDT) has recently announced the investment of \$63 million into a Commercialization Strategy. Details have yet to be announced for this program which may represent a potential investment partner.
  - Other potential sources of capital include:
    - Genome Canada, Ontario Genomics Institute
    - The Canadian Institutes of Health Research (CIHR)
    - The Canadian Foundation for Innovation (CFI)
    - Natural Sciences and Engineering Research Council (NSERC)
    - Ontario Innovation Trust
    - Ontario Research and Development Challenge Fund (ORDCF)
    - Northern Ontario Heritage Fund Corporation (NOHFC)
    - FedNor
    - Not-for-profit foundations (i.e The Heart and Stroke Foundation, The Canadian Cancer Society, The Canadian Diabetes Association)





- *Database development* – The database and information technology assets required will be identified and established. There will be a focus on integration with other genomics databases (i.e. NCBI) and linking to the health database that will be formed as part of the public health subcluster, as well as a focus on leveraging existing assets within Northern Ontario.
- *Human resource requirements* – The database will be operated by a Database Manager who will be responsible for maintaining the database, uploading information supplied by partners, assigning access rights, maintaining security, and acting as the point of contact for MitoNorth in business development opportunities.
- *Development of comprehensive and transparent operating principles and guidelines* – The guiding principles pertaining to the ethical, confidentiality, security and intellectual property issues will be determined in association with the various stakeholders and investors.
- *Marketing and outreach* – National and international scientists and research organizations of related research specialties will be targeted in an awareness campaign that will encourage the use of and submission to the MitoNorth database. Many of these functions can be coordinated through both the Regional Innovation Network and MaRS. The Regional Innovation Network will be an important advocate and public relations partner in this initiative.
- *Public recruitment* – Following approval of the organization's ethical and operational structure a public communications campaign will be implemented to ensure community support and to recruit participants for the purposes of data collection. This campaign can be coordinated through local healthcare providers and organizations.

### Step 2: Pilot Research Project

The initial goal is to create a database of 5,000 individuals with a focus on investigation of linkages between genomics data and cancer due to exposure to industrial materials.

In particular, this pilot research project will build upon the work conducted at the Northeastern Ontario Regional Cancer Centre in industrial carcinogenesis by examining the impact on mitochondrial DNA.

Sample collection for this project will be carried out by all participating partners specific to their needs (i.e. specific ethnic or patient populations). Additionally, specialized cell-lines used for cancer studies or other samples can be incorporated as needed by the various stakeholders. The samples would be stored by the individual partners at their facilities. The associated medical history and other related data will also be managed and stored by the participating partners.

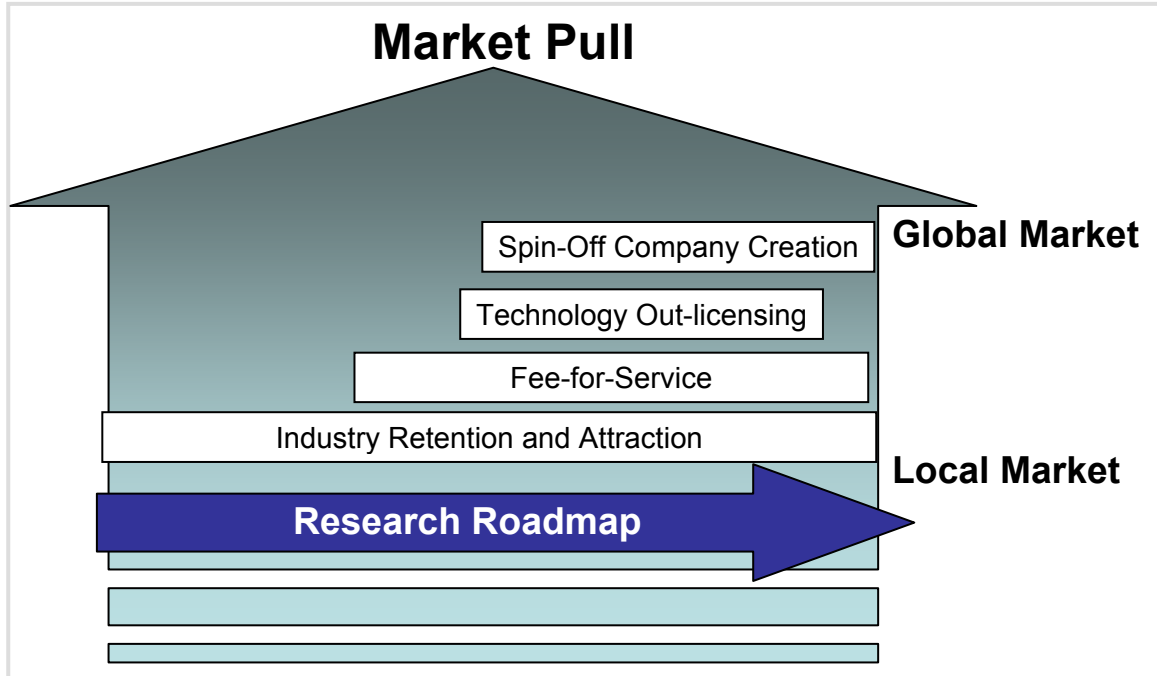
- *Sample collection* – Participant samples will be collected, the mtDNA sequenced and characterized. This information will be entered into the database along with the relevant clinical information.
- *Data analysis* – Under the direction of researchers in Northern Ontario, working together with international collaborators, detailed examination of the database will be conducted to establish if there are linkages between changes in mtDNA associated with industrial carcinogenesis.
- *Publication* – The outcomes of the pilot research project will be published in a reputable peer-reviewed scientific journal, such as Nature Genetics. External validation through publication will help to establish the utility of the database and build significant international profile.

### **Step 3: Development of Commercial Opportunities**

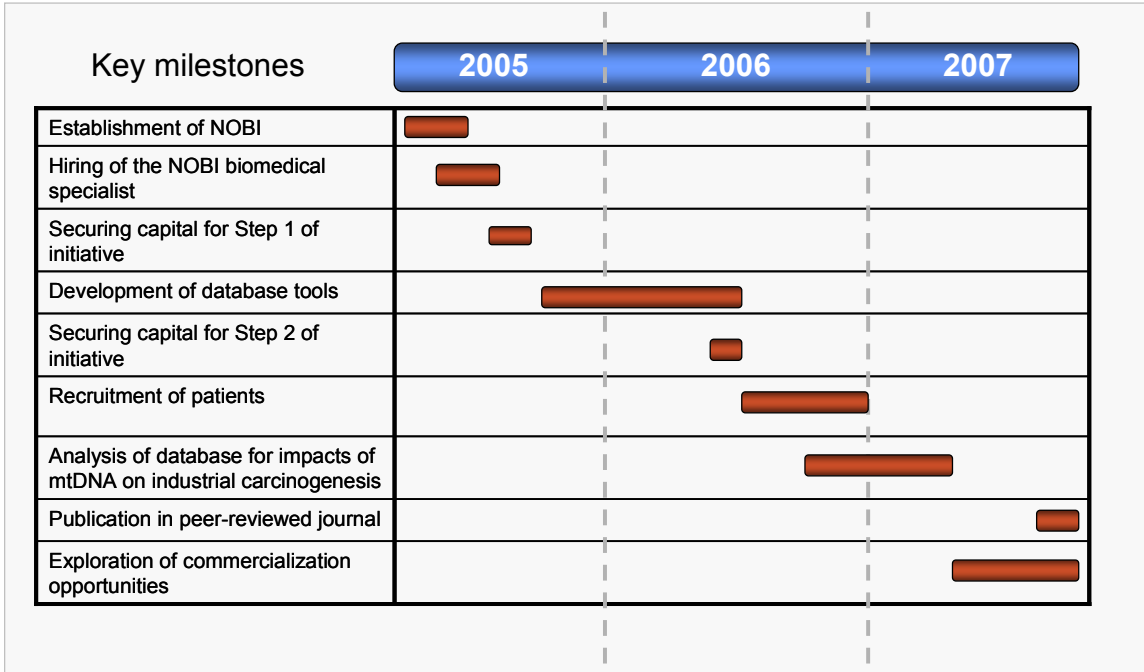
Once the database is operational and of sufficient size, it can be used as a tool for addressing broad biomedical questions. The value of this database will continue to grow as the number of datasets continues to increase and a key component of this initiative will be to continue to grow the database. In addition, as the field of mitochondrial medicine continues to grow and gain recognition, the database will become an increasingly important commercial resource. The objective of Step 3 will be to develop commercial opportunities and to identify potential private sector partners and investors. The specific activities of this step include:

1. *Technology out-licensing* – The intellectual property developed by this initiative may be out-licensed to develop ongoing sources of revenue that will assist in the project becoming self-sustainable. The out-licensing activities will be assisted by the technology transfer infrastructure which is currently present at both Lakehead and Laurentian Universities and at NEUREKA!, as well as through the Regional Innovation Network. Local companies, investors and stakeholders may be given a favourable status (i.e. right of first refusal) to the intellectual property depending on the terms and agreements established in step 1.
2. *Fee-for-service research* – The organization will be able to offer bioinformatics expertise and target identification services to various organizations and can undertake specific investigations as a contract research organization. Such arrangements may include significant backfilling of data.
3. *Fee-for-service access* – Access could be made available to private companies on a fee-for-service basis while the partners of the MitoNorth database would continue to maintain free access. Academic institutions, not-for-profit health research organizations and charitable foundations would maintain free and unrestricted access.
4. *Company creation* – Business opportunities will be actively identified that are self-sustaining which can be developed into new companies.

5. *Industry retention and attraction* – This research initiative will help local companies to build profile and provide an ongoing revenue stream in the processing of samples to be included in the database. This initiative may also serve to help to attract new businesses to Northern Ontario.



**Timelines & Milestones**



### 3.11.2 Bioenergy

#### Overview

Northern Ontario, with its vast resource of biomass stored within the forests, has an opportunity to take a leadership position in Ontario in both the production of bioenergy and associated value-add products from forest biomass, as well as the adaptation of technology (“incremental innovation”) required to create bioenergy. There is an opportunity to explore both local technology developed within Northern Ontario and to adopt nascent imported technologies for local advancement.

In order to establish Northern Ontario’s leadership position in bioenergy a number of steps have been identified:

1. Geo-referenced mapping of biomass and non-timber forestry products including coproducts such as municipal waste and industry waste products. Significant data already exists in this area and new data will be collected both to fill specific knowledge gaps and to support planned pilot initiatives.
2. Inventory of energy utilization of Northern communities. This market information establishes the local market need/pull for energy.
3. Technology sourcing and attraction of specific technologies to meet local energy needs.
4. Planning and implementation of demonstration/pilot scale projects. This will include sourcing of the necessary capital and partnerships for such projects.

#### Background

The use of renewable biomass<sup>75</sup> as an alternative to petrochemical-based industrial chemicals to produce bioenergy or biopower creates additional value in farm, forestry and other industries and reduces waste streams. Bioenergy reduces the emissions of greenhouse gases and other pollutants and lessens the dependence on a non-renewable resource. By creating greater energy diversity from domestically available sources bioenergy can reduce dependence on imported energy. In Canada, approximately 7% of retail gasoline is blended with ethanol<sup>76</sup>. The current annual production of ethanol in Canada is approximately 240 million litres, of which 175 million litres is fuel ethanol<sup>77</sup>. The production of biobased fuels is both a current and growing market opportunity. In instance, Canadian production capacity is unable to meet national demand as approximately 100 million litres are imported from the USA and this fuel is primarily destined for Ontario and Quebec. In addition, the following future targets have been set by the Canadian Climate Change Action plan<sup>78</sup>:

- To produce 1.4 billion litres of ethanol by 2010 (up from 240 million litres in 2001)
- To produce 500 million litres of biodiesel by 2010 (up from zero in 2001)

---

<sup>75</sup> Biomass is any organic matter, particularly cellulosic or lingo-cellulosic matter, which is available on a renewable or recurring basis, including trees, plants and associated residues; plant fiber; poultry litter and other animal wastes; industrial waste; and the paper component of municipal solid waste.

<sup>76</sup> [www.climatechange.gc.ca/english/newsroom/2003/bg-ethanol.asp](http://www.climatechange.gc.ca/english/newsroom/2003/bg-ethanol.asp)

<sup>77</sup> Innovation Roadmap on Bio-based Fuels and Industrial Products (2004), prepared by Acton White Associates Inc.

<sup>78</sup> *Ibid*

This shift to biobased energy is a global initiative as the USA has also set future targets for the increased utilization of renewable energy sources. For instance, the Roadmap for Biomass Technologies in the United States has published the following targets for its vision<sup>79</sup>:

- Biomass consumption in the industrial sector will increase at an annual rate of 2 percent through 2030.
- Biobased transportation fuels will increase from 0.5 percent (2001) of US transportation fuel consumption, to 10 percent in 2020 and by 20 percent in 2030.

Given the vast biomass resources present in Northern Ontario, the region is positioned to become an important partner in the development and production of biobased fuels. In addition, Northern Ontario is also a major shipping hub for the transportation of grain cereal and oilseed crops from the west. Given that extensive transportation infrastructure (rail and port) currently exists in major centres such as Thunder Bay and Sault Ste. Marie, there is the potential to establish manufacturing and processing facilities to create an integrated, provincial network for the generation and distribution of bio-based fuels.

Modular power systems or distributed energy systems are small energy systems that can be used to provide power at or near a customer's site and are commonly used in farming operations. These systems typically consist of a fuel processor and an electric generator and help to supply electricity to rural areas, businesses, and the billions of people who live without power worldwide. Generally, distributed energy systems use locally available biomass fuels such as wood, crop waste, animal manures, and landfill gas to produce bioenergy. Small modular biomass systems fulfill the greatest market potential for distributed, on-site, electric power generation throughout the world. Users may attach the systems to existing transmission and distribution grids close to where consumers use electricity. Consumers may connect their units to the power grid on the customer's side of the electric meter. Modular biomass systems offer the benefit of little environmental impact to potential customers and attractive economics for owners to connect the unit to a power grid that buys unused power.

Various technologies can be utilized to convert biomass into usable energy. Some of these common technologies are described below:

- **Direct combustion** involves the burning of biomass with excess air, producing hot flue gases that are used to produce steam in the heat exchange sections of boilers. The steam is used to produce electricity in steam turbine generators.
- **Co-firing** refers to the practice of introducing biomass in high-efficiency coal fired boilers as a supplementary energy source. Co-firing has been evaluated for a variety of boiler technologies including pulverized coal, cyclone, fluidized bed and spreader stokers.
- **Fermentation** of cellulosic feedstocks, typically agricultural crops like corn, wheat and barley, is used to produce ethanol. Ethanol production in the United States is currently about 10 billion litres a year and is targeted to reach 19 billion by 2012, and Canada imports approximately 100 million litres of ethanol each year from the United States<sup>80</sup>.

---

<sup>79</sup> The Roadmap for Biomass Technologies in the United States, December 2002

<sup>80</sup> Discussion Draft: Innovation Roadmap on Bio-Based Fuels and Industrial Products. K. White and P. Gunther, Acton White Associates Inc. February 9, 2004.

- Biomass **gasification** for power production involves heating biomass in an oxygen-starved environment to produce a medium or low calorific gas. This "biogas" is then used as fuel in a combined cycle power generation plant that includes a gas turbine topping cycle and a steam turbine bottoming cycle.
  - Biomass **pyrolysis** refers to a process where biomass is exposed to high temperatures in the absence of air, causing the biomass to decompose. The end product of pyrolysis is a mixture of solids (char), liquids (oxygenated oils), and gases (methane, carbon monoxide, and carbon dioxide). Vancouver-based DynaMotive Energy Systems Corporation is a recognized world leader in "Fast Pyrolysis Technology". In addition, Ensyn, which has an office in Ottawa, is also marketing its Rapid Thermal Processing technology for processing biomass into biofuel.
- Case Study:** Ottawa-based Iogen Corporation has developed technology that utilizes enzymatic process to breakdown waste straw and wood chips into ethanol on a commercial scale. This is an important innovation that expands the biomass available for ethanol production beyond traditional crop plants, like corn. Iogen has plans to develop a full-scale commercial plant in 2005.
- **Anaerobic digestion** is a process by which organic matter is decomposed by bacteria in the absence of oxygen to produce methane and other byproducts. The primary energy product is a low to medium calorific gas, normally consisting of 50 to 60 percent methane.
  - **Biodiesel** is an alternative fuel that is produced by chemically combining vegetable oils and animal fats with an alcohol (methanol) to produce chemical compounds known as methyl esters. Biodiesel is a desirable substitute for petroleum diesel because it can be used in standard diesel engines without any modification.
  - Combined Heat and Power (CHP) or **cogeneration** facilities achieve high efficiencies by using both the power and the excess heat from burning biomass. Such facilities are a major producer of bioenergy today and are commonly located at forest product industry sites.

In addition to energy, biomass can be utilized in the production of many co-products, such as bioplastics, adhesives, biocomposites, and biolubricants. Many of these co-products are produced as byproducts of bioenergy processes and opportunities exist to explore commercial applications. In many cases, these co-products serve as important economic drivers in the energy production process.

The alternative energy market in the United States was 373 billion kilowatt hours in 2002<sup>81</sup>. The market for bioenergy is based on several factors including providing consumers with green options and providing industry with more cost-effective and reliable sources of energy. Green power marketing provides choices for consumers to purchase power produced from renewable or environmentally preferred sources, such as biomass. Green pricing allows customers to support a greater level of investment in renewable energy technologies by paying a premium on their electric bill to cover the incremental cost of the additional renewable energy.

---

<sup>81</sup> Alternative Power Generation in the USA (September 2003), Euromonitor 2004

**Case Study:** The U.S. Department of Energy's Small Modular Biomass Initiative works with industry to develop small modular biomass systems that are efficient and clean. In 1998 the National Renewable Energy Laboratory in Golden, Colorado and Sandia National Laboratories in Albuquerque, New Mexico, began work on the Small Modular Biomass Initiative. This two-phase project includes feasibility studies, prototype demonstrations, and system integration based on a business strategy for commercialization. In the first phase of the Small Modular Biomass Initiative, ten projects aimed to determine the feasibility of developing systems that are fuel flexible, cost effective, efficient, and simple to operate. Phase 1 also focused on minimizing environmental impacts and addressed key technical, operating, and logistics issues. Phase 1 produced very promising results and the Initiative moved on to Phase 2 involving prototype systems. The U. S. Department of Agriculture Forest Service is actively involved in the program. They collaborate in the deployment and evaluation of demonstration projects because small modular biomass units offer a valuable tool for supporting clean up and maintenance of the national forests. A new emphasis on forest thinning for fire suppression will make additional wood materials available for conversion to fuel. Small modular biomass units will use the waste wood to generate electricity close to the wood source, providing power in remote locations while consuming the waste material.

Government policy is an important factor impacting the bioenergy market. The government can help to set policies that help to reduce taxes on biofuels and establish incentives to build and use biofuels. Globally a need has been identified to reduce greenhouse gases in order to address climate change. In 1997, Canada with 160 other countries met in Kyoto, Japan and agreed to set targets to reduce greenhouse gas emissions in the Kyoto Protocol. Canada's target is to reduce its greenhouse gas emissions to 6 percent below the 1990 levels by the period between 2008 and 2012. This target is not yet binding as the Kyoto Protocol requires ratification by at least 55 countries and which represent at least 55% of global greenhouse gas emissions. Increasingly, Canadian government policy has been supportive of the alternative power market in support of the Kyoto targets as well as to bring environmental benefits to Canadians. Northern Ontario, through NOBI and other initiatives, continues to demonstrate a commitment to increasing the utilization of renewable energy. Industry Canada has stated that Canadians can envision a future where:

*With sustainable production and use of biomass to produce fuels, chemicals and materials, economic opportunity and value-added will increase, pollution and greenhouse gas emissions will decrease, new employment will be created and the quality of life in Canada will improve.<sup>82</sup>*

### **Regional and Biotechnology Assets to be Leveraged**

Canada has an estimated 10% of the world's forests and an estimated reserve of forestry biomass equal to 69 times its annual consumption of fossil fuels. Northern Ontario is rich in biomass that could be utilized for the production of bioenergy and other co-products, particularly forestry biomass.

---

<sup>82</sup> Industry Canada, *Vision for the Biobased Economy in Canada*, Draft 13 February 2003



**Case Study:** Radiant Technologies Inc. is a privately-owned company actively commercialising a patented microwave-based extraction process, licensed from the Government of Canada, that has applications for bioprocessing. Radiant Inc. has benefited from the ability to access public office space and state-of-the-art laboratories and pilot plant facilities. “As an early-stage company, we have a very significant advantage in that we do not have to focus on developing facilities. This of course means we are able to direct all our resources to the critical product development activities required to drive the company forward and deliver on our strategy.” – Dr. Steven Splinter, Radiant’s founder.\* This is an example of commercial opportunities that can be developed in partnership with Government research assets.

\* *Foragen Visions Vol(2)2*

In addition, Northern Ontario has a yet unexplored market for bioenergy, especially in rural and remote areas. These are ideal markets for the establishment of small distributed energy systems that can be designed to meet local needs and to funnel additional energy production onto the provincial energy grid. In this way, economical, reliable and sustainable energy is available for use by local consumers, including industry. Northern Ontario is also home to some of Canada’s largest consumers of energy, namely the forestry and mining sectors. The forestry industry continues to develop methods to generate energy to power their operations and is therefore receptive to bioenergy initiatives. Additionally, the Ontario mining industry is a major stakeholder in the development of new energy solutions as it spent \$215 million on electricity and slightly more than \$100 million on natural gas in 2001<sup>83</sup>. Given that energy is a significant cost driver for the mining industry there is the potential for the adoption and utilization of alternative energy sources, such as those produced from forestry biomass. Many municipal, provincial and federal governmental institutions within Northern Ontario are interested in bioenergy and could become the first users of energy produced from local biomass. One of the first priorities of the bioproducts specialist will be to initiate the biomass inventory and energy utilization data gathering process that will assess the current market conditions for a broad bioenergy initiative.

While there is currently a shift towards environmentally-friendly technologies at the national level (i.e. Kyoto accord) it should be noted that Northern Ontario has indicated a strong commitment to developing biotechnologies that preserve and respect Ontario’s rich ecological and cultural heritage. In this regard, there are many potential partners within Northern Ontario for a bioenergy initiative.

- The Ontario Forestry Research Institute (OFRI) of the Ministry of Natural Resources (MNR) is a key partner in Northern Ontario as they hold key information on biomass, sustainability, and forestry licenses. OFRI has the capability to lead many components of this project, in particular the requirement for greater knowledge of biomass quantity, characterization and sustainability.
- Great Lakes Forestry Centre (GLFC) in Sault Ste. Marie has strategic growth initiatives in the areas of Climate Change and Other Major Forest Disturbances and Forest Productivity
- Lakehead University, in Thunder Bay is home to key forestry research in Northern Ontario and also has supercomputing capacity, a key requirement is large scale biomass mapping and modeling. Other sources of potential computing assets that could be utilized for this initiative are located at MIRARCO

<sup>83</sup> Institute for Policy Analysis, 2002 “The Economic and Fiscal Contribution of the Mining Industry in Ontario”

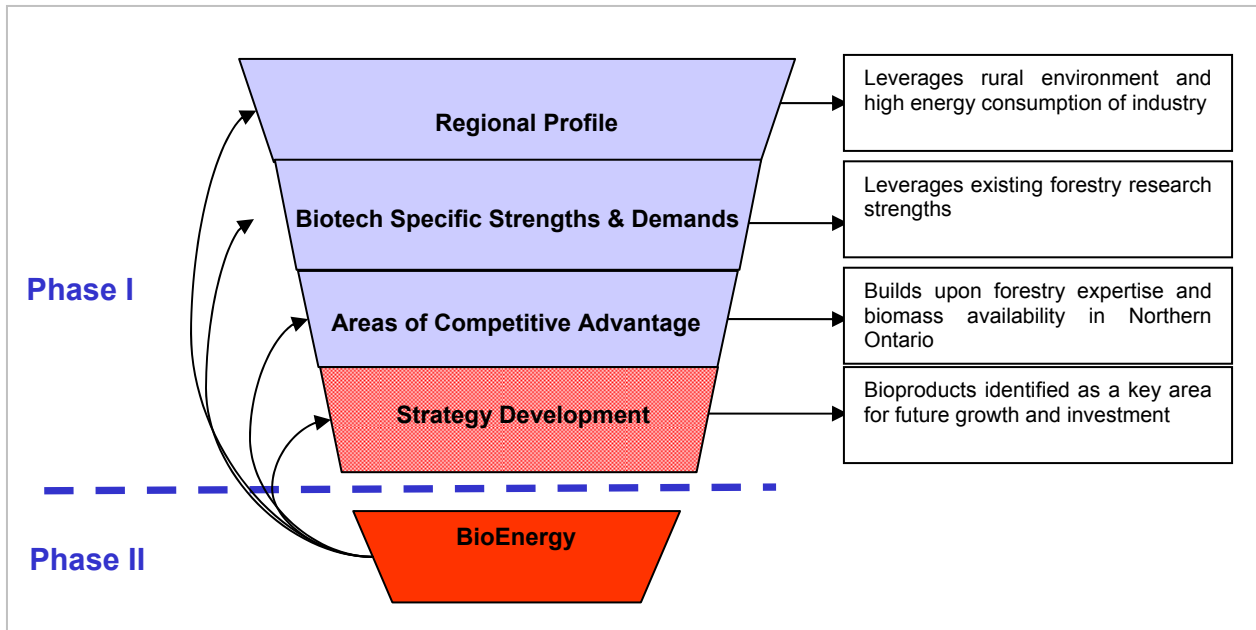
- in Sudbury, and in the bioinformatics companies currently serving the forestry industry located through Northern Ontario, but in particular located in North Bay.
- Other public research partners include The Centre for Forestry in Northern Ontario (CEFNO), Centre for Northern Forest Ecosystem Research (CNFER), the Legacy Forest initiative, the Lakehead University Centre for the Application of Resources Information Systems (LU-CARIS), the New Liskeard Agricultural Research Station (NLARS) and The Forestry (Lakehead University) Research Partnership.
  - The Greater City of Sudbury has developed expertise in the completion of an energy inventory of their community. Such expertise could be applied to other communities through this initiative.
  - Potential private sector partners include Topia Energy, Tembec and EcoEnergy.

**Case Study:** The Anaerobic Digester Project at Circle 'D' Farms was a pilot scale project, supported by the Northern Ontario Heritage Fund Corporation, that demonstrated the successful development of a distributed energy system. This project developed a digester that was successfully used to convert biosolid waste from a dairy farm into a source of energy. The digester was self-powered and improved the farm's manure handling and storage capabilities. One of the aims of this project is to develop a system that can generate enough energy to power the operations of the entire farm and to sell the surplus electricity back to the grid. This project has exciting commercial potential because it assists in waste handling and provides an environmentally-friendly energy source. Another promising outcome of this system is to produce a commercial liquid and solid fertilizer product from the waste-streams from the digester.

### **Business Concept**

Bioenergy and distributed power systems have great potential for commercial growth in Northern Ontario. There are opportunities to work with consumers of energy, from municipalities, to institutions to the private sector, to explore sustainable energy sources based on the biomass resources of Northern Ontario. For instance, the mining industry has the capacity for large capital projects to improve productivity, reduce costs and to ensure alignment with current national and provincial policies regarding the environment and public health. Industrial partnerships with the forestry and mining sectors will produce significant opportunities for local innovation. This will be especially relevant to the adaptation of existing bioenergy technologies that have been designed for operation using agriculture biomass to operate on forestry biomass. This innovation can be developed and commercialized through existing companies in Northern Ontario, through out-licensing arrangements and/or through the creation of new spin-off companies focused on bioenergy.

Bioenergy initiatives will be operated through the bioproducts specialist of NOBI. The networking and commercialization support services offered through NOBI will be a key asset. In addition, this bioenergy initiative is aligned with Ontario's *Bioproducts* subcluster and Northern Ontario is poised to contribute an important in the development and commercialization of bioenergy resources. This initiative was been identified during the Biotechnology Cluster Innovation Program and has been developed in response to regional strengths and needs of Northern Ontario, as outlined below.



### Steps to Move Forward

There are several steps for this ambitious project which are described below.

**Step 1: Inventory Development and Maintenance** – Significant data has been collected to date by various provincial and federal agencies regarding forestry biomass and energy usage. However, additional information is required to develop a further understanding of the resources and the regional demands that exist. In order to establish a clear understanding of the potential availability of biomass for bioenergy production in Northern Ontario and the need to develop a distributed energy system two key inventories need to be established. These inventories pertain to 1) the biomass availability and current utilization pathways and 2) regional energy utilization levels and patterns.

**The Biomass Inventory** – this database will characterize the following questions that need to be further addressed:

- What is biomass in Northern Ontario currently used for?
- How many jobs are created per m<sup>3</sup> harvested? What is the economic impact?
- What is currently not being used? i.e. slash, thinnings, mortality from fire, insects and disease
- How sustainable is the biomass that is currently available?
- When will current forestry management practices make additional biomass available?
- What contribution can agriculture make to biomass in Northern Ontario?

The inventorying of biomass in Northern Ontario is envisioned to be a long-term and ongoing project. As specific pilot/demonstration projects are selected further questions will arise and will be addressed through the ongoing activity of the biomass inventory initiative.

**Case Study:** In March 2004, DynaMotive Energy Systems Corporation of Vancouver announced its proposed participation in the development of what could become the world's first distributed power generation network utilizing pyrolysis oil in Northern Ontario. The project, led by the Public Utility Commission of Sault Ste. Marie, envisages the installation of a combined heat and power plant in Sault Ste. Marie and the development of a remote BioOil plant to service this project and potentially other generation facilities in the municipality. This cogeneration project is an example of distributed energy production as the energy is produced where it is consumed. This enhances security of supply, avoids electrical transmission and distribution losses and, because it uses the thermal energy produced from the turbine for heating and cooling, achieves an energy efficiency of more than 80%.

DynaMotive is an energy systems company that is focused on the development of innovative energy solutions based on its patented fast pyrolysis system. Through the application of fast pyrolysis, DynaMotive has shown how to unlock the natural energy found in the world's abundant organic resources that have been traditionally discarded by the agricultural and forest industries and to economically convert them into a renewable and environmentally friendly fuel. DynaMotive has successfully demonstrated conversion of these residues into fuel known as BioOil, as well as char, and in doing so establishing these residues as a renewable, environmentally friendly and cost competitive energy reserve. BioOil is produced by fast pyrolysis of wood and other organic materials. The primary feedstock for the production of BioOil is expected to be unutilized wood biomass from forest industries or harvesting operations (slash currently burned at roadside) in the Algoma District. Another potential feedstock for BioOil is municipal sewage sludge.

The project consortia includes: PUC (Sault Ste. Marie), The Great Lakes Forestry Centre, the Ontario Forest Research Institute, the Municipality of Sault St. Marie and Magellan Aerospace, Orenda Division and Dynamotive.

***The Energy Inventory*** – The local, commercial opportunities for bioenergy must be explored. In particular, it is essential to develop an understanding of the types of energy that local consumers, such as municipalities, institutions, and industry, require. For example, The Greater City of Sudbury has been successful in attracting Topia Energy to Sudbury to establish a biodiesel production facility. The availability of an energy inventory for Sudbury was a key factor in Topia's decision to establish operations there. As a distributed energy system is specifically designed to meet the needs of local energy consumers, a strong understanding of the needs of the local customer must be established in priority setting for pilot/demonstration projects.

The outcomes of this first step will be critical to defining Northern Ontario's role within the provincial strategy for bioproducts. A comprehensive inventory of the regional biomass resources and of the local energy requirements will be essential to Step 2, which outlines Northern Ontario's positioning as a demonstration centre to test pilot scale bioenergy initiatives. In this manner, Northern Ontario is positioned to become both a supplier of biomass for bioenergy production and to also provide the required

manufacturing infrastructure and engineering expertise needed to convert biomass into bioenergy.

**Step 2: Technology Partnering, Sourcing and Attraction** – In order to meet the energy needs of local consumers, technology will be required. While some of this technology may be sourced locally, it is anticipated that much of the required technology will be sourced from companies and research institutions outside of Northern Ontario. Such technology is also not anticipated to be “turnkey” and instead will require significant incremental innovation and adaptation to meet local needs, in particular in the area of operating using forestry biomass. An important aspect of this step is to develop capabilities in line with the Provincial strategy in *Bioproducts*.

**Case Study:** Topia Energy, the Ottawa-based producer of BioDiesel, has recently announced that they plan to locate their first Canadian production facility in Sudbury. Topia was attracted to Sudbury because of the local mining companies which are net consumers of energy, the proximity of the region to both Southern and South-Eastern Ontario markets, and because of the availability of underutilized farmland within close proximity that allows the agriculture sector to operate in proximity to the market for biodiesel. It takes approximately 10,000 acres of canola and/or soy to produce three million litres of BioDiesel, and there is over 10,000 acres of active canola and soy growth taking place between Timiskaming and the Nipissing/Greater Sudbury regions combined. A report commissioned by the Temiskaming Grain Growers Association (TGGA)<sup>1</sup> outlined the production of 8,500 acres of canola and 3,000 acres of soybeans within the Temiskaming region for the 2000 growing season. The TGGA is developing plans for a combined crushing/feed plant and biodiesel facility to fully utilize the crops produced in the region. The City of Greater Sudbury has identified green energy as one of the five engines of economic growth in its 2015 Economic Development Plan, and in support of this has moved several City vehicles over to run on BioDiesel. BioDiesel can also be used by local mining companies and any other transportation fleet to replace electric or diesel-powered vehicles with a more efficient and less polluting way of moving materials underground.

<sup>1</sup> *Temiskaming Oilseed Industry Evaluation and Action Plan: A feasibility study prepared by JRG Consulting Group. January 2001*

### **Step 3: Capital Sourcing**

There are many potential sources of funding to support a bioenergy initiative. Some of these are detailed below:

- **Climate Change Funding Initiative (CCFI)**<sup>84</sup>, delivered by the Canadian Agri-Food Research Council (CARC) and funded under the Canadian Adaptation and Rural Development (CARD) Fund, has four major components. The first focuses on developing and increasing the pool of experts in the field of climate change in Canada by supporting projects involving graduate students in climate change science. The second places a priority on the creation of science networks, where integrated teams of experts and industry partnerships address fundamental knowledge gaps and technology development. The third component allows for the dissemination of information and brings experts together to share results and develop priorities for future action. Finally, the project sets in motion the coordination of climate change activities in Canadian agriculture within CARC that will continue beyond the CCFI program.

<sup>84</sup> [http://www.agr.gc.ca/policy/adapt/national\\_initiatives/climatechange.phtml](http://www.agr.gc.ca/policy/adapt/national_initiatives/climatechange.phtml)

- **Natural Resources Canada's** Climate Change Impacts & Adaptation Program<sup>85</sup> provides funding for targeted research and activities that will contribute to a better understanding of Canada's vulnerabilities to climate change and provide information necessary for the development of adaptation strategies.
- **Sustainable Development Technology Canada (SDTC)**<sup>86</sup> funds projects that focus on the development, demonstration and pre-commercialization of new technologies that address climate change and clean air issues. SDTC funds public-private partnerships.
- **Canadian Agricultural Rural Communities Initiative (CARCI)**<sup>87</sup> funded through Canadian Adaptation and Rural Development (CARD) program may provide funding for bioenergy initiatives, especially those designed to utilize agricultural biomass in Northern communities.
- The **Ontario Ministry of Agriculture and Food (OMAF)** through its Alternative Renewable Fuels Research and Development Fund<sup>88</sup> is a potential funding partner for bioenergy initiatives.
- **GeoSmart**<sup>89</sup> is a program designed to support the implementation and enhancement of Geographic Information Systems (GIS) in Ontario's municipalities, First Nation communities, and Conservation Authorities, and may be particularly relevant funding mechanism for the first phase of the bioenergy project. GeoSmart is a \$32 million SuperBuild initiative led by the Ministry of Natural Resources and provides funding up to 50% of a project's total eligible costs, generally not exceeding \$500,000.
- **Green Municipal Funds**<sup>90</sup> from the Federation of Canadian Municipalities consists of a \$250-million endowment from the federal government and are designed to remove investment barriers to green municipal infrastructure, such as real or perceived risks and higher capital costs. The Funds' priorities are to cut greenhouse gas emissions, to improve local air, water and soil quality, and to promote renewable energy.
- The **ENFOR (ENergy from the FORest)** program, funded through the interdepartmental Program of Energy Research and Development (PERD). was established in 1978 to generate sufficient knowledge and technology to realize a marked increase in the contributions of forest biomass to Canada's energy supply. The program is part of a federal interdepartmental initiative on energy research and development. It is coordinated by Canadian Forest Service (CFS) and most projects are managed by the five CFS research centres.
- The Ontario Ministry of Economic Development and Trade (MEDT) has recently announced the investment of \$63 million into a Commercialization Strategy. Details have yet to be announced for this program which may represent a potential investment partner.
- Other potential funding mechanisms for bioenergy projects in Northern Ontario include **FedNor** and **Northern Ontario Heritage Fund (NOHFC)**, both of which focus on fostering private sector job creation.

---

<sup>85</sup> [http://adaptation.nrcan.gc.ca/proposal\\_e.asp](http://adaptation.nrcan.gc.ca/proposal_e.asp)

<sup>86</sup> <http://www.sdtec.ca/en/funding/ep.htm>

<sup>87</sup> [http://www.agr.gc.ca/carci/carci\\_e.html#ground](http://www.agr.gc.ca/carci/carci_e.html#ground)

<sup>88</sup> <http://www.gov.on.ca/OMAFRA/english/research/arfuels/cfp.htm>

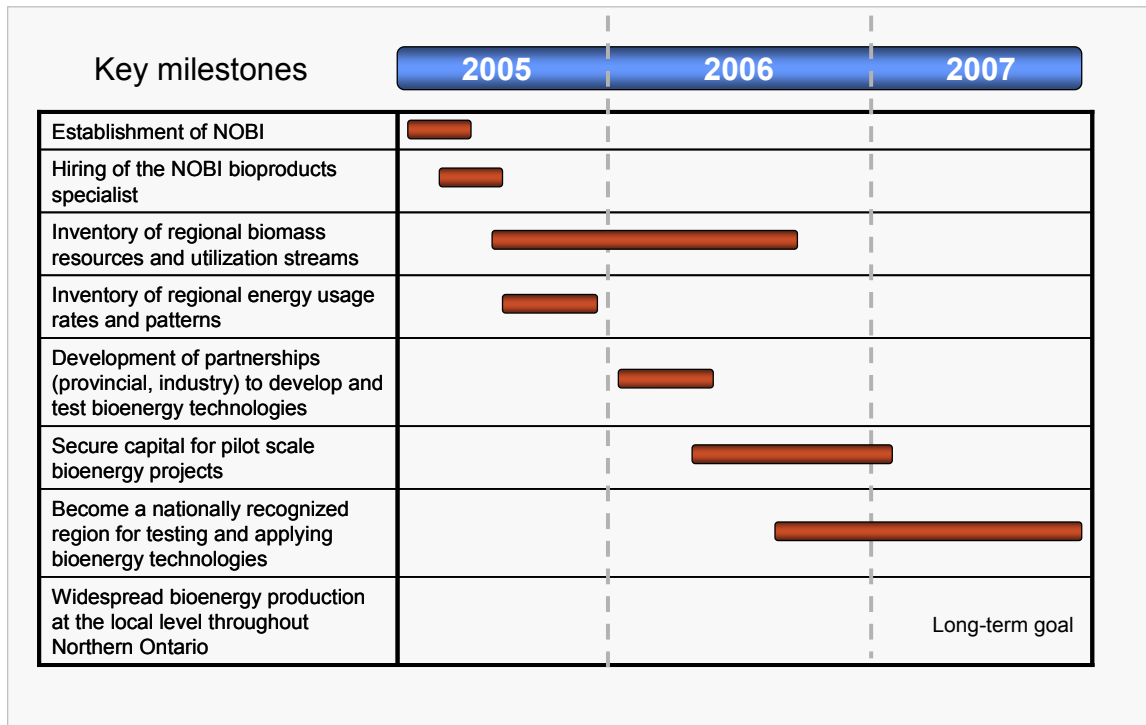
<sup>89</sup> <http://www.geosmart.gov.on.ca/aboutgeosmart.cfm>

<sup>90</sup>

**Step 4: Implementation**

- Identification of projects with industrial partners that will collaboratively develop technologies for commercialization
- Develop the physical infrastructure needed for larger scale initiatives in collaboration with communities, industry and in parallel to the provincial *Bioproducts* strategy.
- Train, attract and retain the highly qualified personnel to the region with expertise pertaining to the processing of biomass for the generation of bioenergy
- Initiate pilot/demonstration projects - several bioenergy from biomass demonstration-scale projects will be implemented throughout Northern Ontario. It is anticipated that many small, rural communities will be among the first to benefit from these small-scale demonstration projects. These demonstration-scale projects will illustrate the applicability of technology and seek to develop robust, “turn-key” technology systems that can be replicated broadly throughout Northern Ontario. From successful demonstration of the utility of bioenergy, it is expected that local companies and municipalities will, in partnership, develop larger scale initiatives focused on the economic viability of such projects and on the benefits attributed to lower greenhouse gases. As well, it is expected that companies interested in bioenergy throughout Ontario and Canada will be attracted to Northern Ontario, and therefore this project will serve an important role in company attraction and retention.

**Timelines and Milestones**



### **3.11.3 Bioprospecting: Natural Products and Drug Discovery**

#### **Overview**

Bioprospecting can be defined as the search for economically valuable genetic and biochemical resources from nature<sup>91</sup>. This proposal describes the development of an organization that supports the responsible commercialization of opportunities identified from bioprospecting of Northern Ontario's natural resources, in particular the boreal forest.

#### **Background**

There is tremendous interest in the identification of novel therapeutic agents and industrial products that can be isolated from biological sources. Northern Ontario is rich in natural resources that may serve as a source of such valuable biological products and because of a phenomenon called "Northern Vigour<sup>®</sup>" Northern Ontario may have a distinct advantage as a source of bioactive compounds.

The term "Northern Vigour<sup>®</sup>" is a registered trade mark of the Saskatchewan Seed Potato Growers' Association that is used to describe the phenomenon, first observed in potatoes, that plants grown from seeds from certain northern regions out-yield plants from southern sources of seed. These differences in productivity are attributed to physiological changes in the plant that may have resulted from the strong temperature differences between warm days and cool nights that occurs in northern regions.

One particularly widespread opportunity for bioprospecting is in the identification of pharmacological agents used for the treatment of disease and promotion of health derived from natural products. Traditional pharmacology typically depended on the application of a relatively limited numbers of samples using a defined physiological or biochemical system, while modern developments in high-throughput screening enabled by robotics, genetic analysis, imaging techniques and other analytical strategies allow for the simultaneous testing of complex chemical mixtures in a broad range of biological assay systems. Screening of compound mixtures obtained from biological samples can be broad in nature, and include analysis of many different cell types for indications. Once compound mixtures have been screened for potential activity, positive samples can be investigated using modern analytical techniques for chemical identification. Each active sample may comprise a great number of chemical agents, each of which is subsequently isolated for individual testing.

#### **Regional and Biotechnology Assets to be Leveraged**

Northern Ontario contains significant research and exploration assets that could be leveraged in a bioprospecting initiative. These include:

- The **Great Lakes Forestry Centre (GLFC)** is a recognized centre of forestry research with experience and infrastructure dedicated to forestry research. The centre has equipment and expertise relevant to natural products and to biochemical research that would be an asset to a bioprospecting initiative. The

---

<sup>91</sup> K. ten Kate, 1995. Biopiracy or Green Petroleum? Expectations & Best Practice in Bioprospecting. - Overseas Development Administration, Environment Policy Department, London.



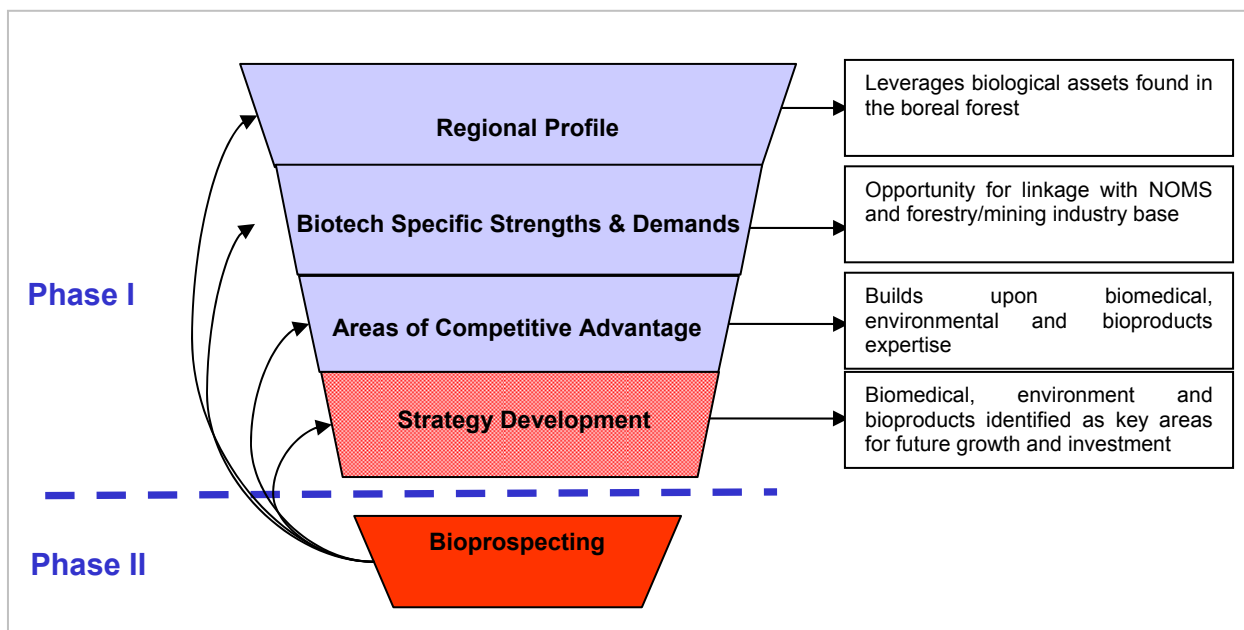
GLFC has an impressive track record of 12 patents in the last 10 years, 650 journal articles, 114 government Information Reports, 158 government technical notes, 94 book chapters and 155 other publications (proceedings, brochures, file reports) in a variety of topics pertaining to forestry research. The GLFC has established collaborations with Health Canada in the area of quality control of biological products. The centre has identified several areas for strategic growth in the coming years including forest biotechnology and bioproducts, climate change and other major forest disturbances, forest productivity, and forest ecosystem processes.

- **Mikro-Tek** is a Canadian biotechnology company, located in Timmins, which produces strains of naturally occurring mycorrhizal fungi that increase the survival and/or growth of plants and trees. Target markets include forestry, land reclamation and agriculture. Since 1990, Mikro-Tek has invested more than \$12 million in research and development of its products. This research has resulted in the commercial product registration of two microbial inoculants, Mikro-VAM® and Mikro-CONE®, with Agriculture Canada's Canadian Food Inspection Agency. Mikro-Tek possesses laboratory facilities to isolate propagate and mass produce fungal products of commercial value.
- The **Mining Innovation, Rehabilitation and Applied Research Corporation (MIRARCO)** is a not-for-profit applied research and technical service company formed through collaboration between Laurentian University and the private and public sectors. It promotes mining innovation and provides a bridge between researchers and industry. In particular, the Centre for Environmental Monitoring (CEM) provides innovative applied multidisciplinary research, monitoring and development services to aid resource industries in the solution of problems in ecosystem remediation, rehabilitation and restoration, and may be of particular significance to bioprospecting.
- The **Northern Centre for Biotechnology and Clinical Research (NEUREKA!)** works to bring Canada's booming biotechnology and clinical research industry to Northern Ontario. NEUREKA! is committed to providing the Canadian and global markets with novel products and services in the areas of life sciences. Its areas of activities include clinical research, biomedical research and development, and environmental biotechnology. Its Biotechnology Division partners with universities, research institutes and industry to transfer basic scientific ideas to products and services and would be a key partner in this initiative.
- **Lakehead University's** Forest Soils Lab and Environmental Laboratory could be utilized in the analysis of samples for bioprospecting. The Forest Soils Lab performs tests of chemical and forest soils as well as vegetation samples. These services are used mainly by land managers interested in the impact of their soils on harvesting and site preparation. The Environmental Laboratory focuses its research on chemical analysis of soils, foliage, water and wastewaters.
- The new **Northern Ontario Medical School (NOMS)** will significantly enhance the biomedical training and research capacity in Northern Ontario, particularly in relation to the opportunity to bioprospect for medically-relevant compounds from the boreal forest. There is an opportunity to bring bioprospecting specialists into Northern Ontario through NOMS as the specific research initiatives of the medical school will depend on the incoming faculty. NOMS is currently filling 20 full-time faculty positions, including 14 basic and 6 scientists. Each of the scientists will retain protected time for research.

- The Northern Ontario Plant Database (NOPD) project<sup>92</sup> funded through the Ontario Living Legacy Trust is a public-private partnership lead by **Algoma University College**, involving educational, government, and forest industry partners. While the mandate of the Living Legacy Trust ended in April 2004, the partners have committed to maintaining this database for a period of 10 years, and continue to seek additional funds from other agencies to continue entry of specimens in the database and herbaria. This database and its associated herbarium can serve as a resource in the bioprospecting project.
- Testmark Laboratories, located at the Sudbury Centre of Innovation and Technology (SCITech) has several environmental testing services and equipment.
- The Living with Lakes Centre – This co-operative centre will become an internationally recognized centre for studying the impact of human activities on the lakes streams and wetlands in northern environments<sup>93</sup>. The centre will provide a critical mass of scientists and infrastructure needed to attract highly qualified personnel to the region.

### Business Concept

The proposed business concept outlines the development of an organization that will explore the opportunity for identification of valuable biological products from the boreal forest in Northern Ontario through bioprospecting, and undertake projects of commercial relevance. Working hand-in-hand with NOBI, this initiative will develop demonstration projects and explore commercial opportunities for bioprospecting in Northern Ontario. This initiative fits well with the provincial government's strategy in several subclusters including bioproducts, and public health and the environment.



<sup>92</sup> <http://www.northernontarioflora.ca/>

<sup>93</sup> <http://coopunit.laurentian.ca/preCFEU/CFEU-ProjectBackgrounder.pdf>

## Steps to Move Forward

### Step 1: Networking Bioprospecting Assets

Through the networking framework established in NOBI, all of the stakeholders within Northern Ontario, including the First Nation's communities, will be engaged in this initiative. In order to understand the infrastructure requirements to move forward, a detailed inventory and gap analysis of current activity in the identification of valuable biological products from Northern Ontario will be completed, as well as a detailed inventory and gap analysis of the assets available for identification, processing, propagation, and commercialization of biological products. This initiative will likely identify several collaborative and joint opportunities that may involve the environment, bioproducts and biohealth specialists of the NOBI regional innovation network.

This inventory process will begin the development of valuable databases including information on Canadian plant species (woody, herbaceous, macroscopic algal) including geographic distribution, published uses, toxicity, prevalence, rare/threatened/endangered status. In addition, data on Canadian microbial species (fungal, bacterial, microscopic algal) including their occurrence, uses and toxicity will be collected. These databases will be an ongoing project of the bioprospecting initiative and will link with the inventorying activities to be conducted by the Bioenergy initiative.

### Step 2: Opportunity Identification

Projects will be identified for pursuit by the bioprospecting organization that hold promise to leverage the assets of

Northern Ontario into commercially viable opportunities. This analysis will include a market assessment which will include:

- Performing a detailed market assessment (i.e. understanding the market demand)
- Outlining the regional competitive advantages to harvest, produce and process the material
- Outline the competitive advantages of Northern Ontario for product and technology development pertaining to the specific initiative

**Case Study:** Diversa Corp., a Californian bioprospecting company, is turning to Canada to find valuable microorganisms. Diversa Corporation is a leader in applying proprietary genomic technologies for the rapid discovery and optimization of novel protein-based products. For instance, in 2004, Diversa launched its Cottonase™ enzyme, a novel, environmentally friendly product for cotton-based textile processing<sup>1</sup>. Diversa is also studying organisms at paper- or pulp-processing facilities on private land at undisclosed locations in Canada<sup>2</sup>. But company officials say they would also like to search public land in Canada. Government officials say they would welcome this as a starting point for wider exploration, which might lead to the commercial exploitation of either land or knowledge held by Canada's indigenous people. Diversa is a leader in applying proprietary genomic technologies for the rapid discovery and optimization of novel products from genes and gene pathways. Diversa has formed alliances and joint ventures with market leaders, such as the Dow Chemical Company, DuPont Bio-Based Materials, GlaxoSmithKline plc, Invitrogen Corporation, and affiliates of Syngenta AG.

<sup>1</sup>

[http://www.diversa.com/presrele/2004/view\\_release.asp?id=20040617](http://www.diversa.com/presrele/2004/view_release.asp?id=20040617)

<sup>2</sup> *Nature* 419, 768 (24 October 2002); doi:10.1038/419768a

- Performing a gap analysis of the regional capabilities and defining the partnership opportunities and linkages

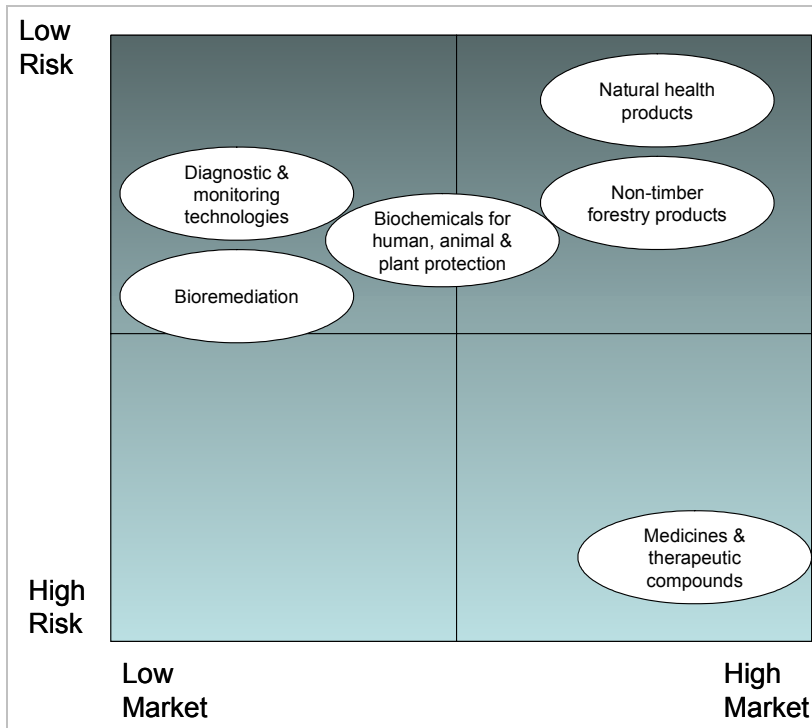
This market assessment will examine the feasibility, mechanism and market potential for each opportunity. Some proposed projects of relevance to the medical field, forestry and mining are detailed in the table below.

<b>Bioprospecting Opportunities</b>	<b>Northern Ontario's Assets</b>	<b>Potential Partners</b>	<b>Examples of potentially commercialized product or technology</b>
Biochemicals for human, animal, or plant protection	<ul style="list-style-type: none"> <li>• The unexplored Boreal forest</li> <li>• The Great Lakes Forestry Centre – extensive biochemistry research assets</li> <li>• The Environmental and Forest Soils laboratories (Lakehead University)</li> <li>• NEUREKA! – bioanalysis and biochemistry assets</li> </ul>	<ul style="list-style-type: none"> <li>• Health Canada</li> <li>• Environment Canada</li> <li>• Private sector forestry companies</li> <li>• Pesticide and chemical companies</li> </ul>	<ul style="list-style-type: none"> <li>• Bioherbicides, bioinsecticides, natural insect repellants, biofungicides, anti-microbials</li> <li>• Plants for agroforestry, e.g., shelterbelts, forest farming, riparian (streambank) buffer zones.</li> </ul>
Medicines and therapeutic compounds	<ul style="list-style-type: none"> <li>• Laurentian and Lakehead Universities</li> <li>• Northern Ontario Medical School</li> <li>• The Great Lakes Forestry Centre – extensive biochemistry research assets</li> <li>• NEUREKA!</li> </ul>	<ul style="list-style-type: none"> <li>• Health Canada</li> <li>• Pharmaceutical Companies</li> </ul>	<ul style="list-style-type: none"> <li>• New drugs &amp; vaccines from plant, microbial, or animal species (note: examples of various plants of medicinal value in Ontario has been published by the National Research Council<sup>94</sup>)</li> </ul>
Natural health products	<ul style="list-style-type: none"> <li>• Northern Ontario Medical School</li> <li>• The Great Lakes Forestry Centre – extensive biochemistry research assets</li> <li>• NEUREKA!</li> </ul>	<ul style="list-style-type: none"> <li>• Health Canada</li> <li>• Agriculture, Agri-food Canada</li> <li>• Pharmaceutical and healthcare companies</li> <li>• Food manufacturing companies</li> <li>• University of</li> </ul>	<ul style="list-style-type: none"> <li>• Nutraceuticals and functional foods</li> <li>• Naturally-derived food processing/preserving compounds.</li> </ul>

<sup>94</sup> Canadian Medicinal Crops, by: Ernest Small, Paul M. Catling, 1999. National Research Council, Canada

		Guelph (agriculture expertise)	
Bioremediation products	<ul style="list-style-type: none"> <li>• Mikro-Tek Inc.</li> <li>• Lakehead and Laurentian Universities</li> <li>• MIRARCO</li> <li>• NEUREKA!</li> <li>• The Living with Lakes Centre</li> </ul>	<ul style="list-style-type: none"> <li>• Mining sector (i.e. Inco, Falconbridge)</li> <li>• University of Waterloo, Dr. B Glick</li> <li>• Environment Canada</li> </ul>	<ul style="list-style-type: none"> <li>• Plants and microbes for bioremediation/reclamation of damaged, degraded, or toxic sites from mining, waste dumping, deforestation, natural and man-made disasters.</li> <li>• Plants for soil (land) erosion control and watershed protection.</li> <li>• Biological agents for water testing, treatment, or purification</li> </ul>
Diagnostic and monitoring technologies	<ul style="list-style-type: none"> <li>• NEUREKA!</li> <li>• MIRARCO</li> <li>• The Environmental and Forest Soils laboratories (Lakehead University)</li> <li>• Testmark</li> <li>• Laurentian and Lakehead Universities</li> <li>• The Living with Lakes Centre</li> </ul>	<ul style="list-style-type: none"> <li>• Environment Canada</li> <li>• Industry Canada</li> </ul>	<ul style="list-style-type: none"> <li>• Functional molecules to be used as biochemical markers, and probes catalysts, carriers</li> </ul>
Non-timber forestry products	<ul style="list-style-type: none"> <li>• The Great Lakes Forestry Centre – extensive biochemistry research assets</li> </ul>	<ul style="list-style-type: none"> <li>• Local forestry industry (Tembec, Bowater, etc.)</li> <li>• Bioproducts manufacturing companies</li> </ul>	<ul style="list-style-type: none"> <li>• New components for industrial materials &amp; manufacturing, e.g., biological dyes, phenolic compounds wood processing chemicals, adhesives, household cleaners, cosmetics &amp; perfumes, hygiene products, novel fibres.</li> </ul>

A preliminary examination of the opportunity within each of these sectors is illustrated in the diagram below:



### Step 3: Implementation and Capital Sourcing

Projects for further development and commercialization will be selected for implementation based on the probability that they will generate valuable intellectual property and their synergy with the assets of Northern Ontario. In particular, opportunities will be identified that utilize the downstream assets of Northern Ontario including:

- Systems to obtain a reliable source of high quality natural product. This may include collection of samples from the source or propagation of materials in a laboratory setting.
- Process requirements to extract biological materials that utilize Northern Ontario's expertise in fibre processing and handling.

Capital sourcing for this implementation of these projects will target the Northern Ontario Heritage Fund Corporation (NOHFC), FedNor and other national and provincial support organizations, including Health Canada's Natural Health Products Directorate<sup>95</sup>.

**Case Study:** It was announced in March 2004 that the Northern Ontario Heritage Fund (NOHFC) will provide \$117,750 to explore the research and development potential for farming Canada Yew in Northern Ontario through a partnership which includes the Great Lakes Forestry Centre (GLFC), the Upper Lakes Environmental Research Network (ULERN), the Ontario Forest Research Institute (OFRI), Thessalon First Nation, and others. Canada Yew is a native shrub from which a valuable anticancer compound is extracted, and the partnership will explore opportunities for farming Canada Yew on northern farms and identify best practices for its cultivation.

<sup>95</sup> [http://www.hc-sc.gc.ca/hpfb-dgpsa/nhpd-dpsn/index\\_e.html](http://www.hc-sc.gc.ca/hpfb-dgpsa/nhpd-dpsn/index_e.html)

#### **Step 4: Commercialization**

Bioprospecting in Northern Ontario has the potential to create significant commercialization activity. Commercialization activities maybe assisted by ScienceWorks (Sault Ste. Marie) which will have a focus on commercialization of research technologies. Potential opportunities that may be commercialized through out-licensing or company creation activities include:

- Methods and tools for bioprospecting, including expertise in policy development, cross-cultural cooperation, and cultivation to preserve natural stocks.
- Intellectual property of significance to industry, including pharmaceutical and traditional industries.

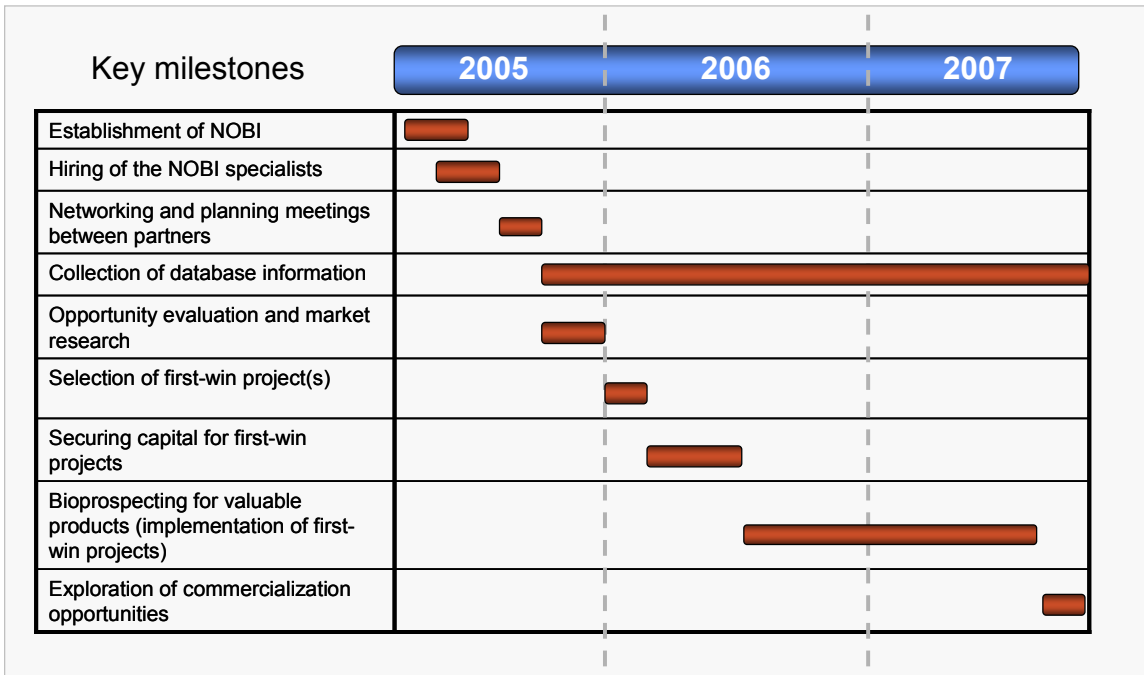
These commercial opportunities will generate a stream of royalty revenue to support further bioprospecting activity and help to offset the operating costs of the initiative. Fee-for-service bioprospecting to address particular questions posed by industry may also be a commercial outcome of the bioprospecting initiative.

In addition, bioprospecting activity in Northern Ontario will serve as a tool for industry retention and attraction. Based on some initial first-win opportunities, companies interested in bioprospecting will be attracted to Northern Ontario for potential product investigation in the boreal forest. As well, downstream activities in harvesting or production, fibre processing and product manufacturing arising from this initiative will serve to allow Northern Ontario companies to diversify their operations, seed new start-ups, and attract new companies to the area.

**Case Study:** Several Canadian companies have developed commercial products and processes that have been derived from bioprospecting activities. Some examples include:

- MycoLogic Inc. (BC) has developed natural, fungal-based products for industrial applications. The company's strengths include experience in the culturing, growth and scale-up of fungi combined with expertise in molecular biology, gene expression and fungal genetics. MycoLogic has a number of unique, patented discoveries it is now bringing to commercialization
- Larex AG extracts arabinogalactans from Larch trees. Their product has recently received FDA approval and can be used as a food substitute to enhance stability.
- Radient Technologies Inc. is a new Canadian company with a patented technology that uses microwave extraction of bioactive compounds from a variety of materials.

**Timelines & Milestones**





### 3.11.4 Telehealth & Medical Robotics

#### Overview

Telehealth is a mature industry with established receptors for innovation in the Canadian provincial healthcare providers. The application of telehealth is uniquely suited to Northern Ontario given the large geographic area with numerous interspersed, rural communities. In this regard, there are currently several initiatives in Northern Ontario that have been active in developing and testing telehealth technologies. Additionally, the development of telehealth in Northern Ontario will continue through the establishment of the Northern Ontario Medical School (NOMS). Given the national and international interest in telemedicine and the existing strengths in Northern Ontario, there are a growing number of opportunities in this sector. These opportunities include:

1. Becoming an important centre for the testing and validation of pilot scale telehealth initiatives (i.e. a demonstration centre)
2. Recognition as an educational and clinical training centre for the use and application of telehealth technologies
3. Developing novel and innovative methods for use in the telehealth sector

Each of these opportunities will have a positive, economic impact in Northern Ontario. In addition, there are several identified partnership opportunities in telehealth that will link Northern Ontario to the rest of the Province and the Nation.

In addition to telehealth, Northern Ontario has growing strengths in the field of medical robotics, which is an exciting and emerging new field of medicine with tremendous commercial opportunities. Currently, medical robotics are being developed at a number of sites throughout Ontario, and Northern Ontario is well suited to play a role in this emerging field. Northern Ontario's role in medical robotics could be initiated at the research and discovery stage leveraging the robotics strengths that exist within the mining sector.

**Case Study:** There are several Provincial initiatives for medical robotics that can be viewed as models of excellence. For instance, the Centre for Minimal Access Surgery (CMAS, McMaster University) has initiated a tele-robotics surgery project. The project will purchase and install telecommunications and tele-robotic surgery equipment in Yellowknife. Additional tele-mentoring sites will be established in Chicoutimi and in North Bay. The Centre for Minimal Access Surgery is funded by McMaster University's Faculty of Health Sciences, St. Joseph's Hospital, Johnson & Johnson Medical Products and Stryker Canada\*. This Centre is an excellent example of a healthcare initiative that is supported in partnership from the local community and by industry. This is the type of partnership model that will be utilized in the development of new telehealth and telerobotic projects in Northern Ontario.

\*Source: <http://www-fhs.mcmaster.ca/pubrel/cmas.htm>

#### Background

Telehealth can be defined as the application of telecommunications and information technology to deliver healthcare and related services and information over large and small distances. The widespread application of telehealth in Ontario is now a reality with

the introduction of the Province-wide Telehealth program that provides a variety of triage and information services to the public. Opportunities in this rapidly developing field continue to develop, such as the:

1. Management and distribution of online medical records
2. Distribution of diagnostic images and pathology results
3. Remote diagnosis and monitoring of patients
4. Education and clinical training methods
5. Real time patient and medical consultations with remote experts

**Case Study:** AMD Telemedicine, Inc., located in the USA, is a leading supplier of medical devices and related peripherals used in telemedicine. AMD Telemedicine Inc. manufactures and markets medical products such as video microscopes and vital-sign monitors. Its systems allow patient information to be transmitted over telephone lines, allowing caregivers to remotely diagnose, monitor and treat patients. Most of AMD's products sell for between \$5,000 and \$20,000.

The global market for telehealth products was recently estimated at \$3.19 billion in 2003 with the potential to reach \$7.6 billion in 2006<sup>96</sup>. Receptor capacity for telehealth technologies is often dependent on the regional or national policies and financial models regarding healthcare delivery. For instance, Japan has become recognized as a growing market for telehealth due to the favourable reimbursement for the use of telehealth solutions in the home care sector<sup>97</sup>. Other examples of growing markets in telehealth include Scandinavia as

many of these countries have government sponsored healthcare programs that are exploring telehealth technologies. For instance, Denmark's import medical market is estimated at \$375 million, and telemedicine is one of the fastest-growing trends in Danish healthcare. Sweden, considered one of the most advanced medical equipment markets in the world, imports an estimated \$850 million in medical equipment and technology. These international examples highlight the growing market opportunities for the telehealth sector.

**Case Study:** A not-for-profit organization, the Canadian Society of Telehealth, has been formed which has an advocacy role, education, information dissemination and other functions to serve Canada's telehealth professionals\*. This Society is currently implementing the National Telehealth Outcome Indicators Project (NTOIP) as a web-based consensus building process for telehealth outcomes and their success indicators. This project will continue to identify the best-practices in Canada and provide guidelines to monitor successes and impact. This information will be an excellent resource for new telehealth initiatives in Northern Ontario to gauge their positive impact on regional healthcare.

\* <http://www.cst-sct.org/index.php>

Canadian receptor capacity for the telehealth sector is also growing. Health Canada maintains a database of current telehealth initiatives across Canada as part of their Office of Health and the Information Highway (OHIH)<sup>98</sup>. Numerous provinces and regions throughout Canada are increasing their utilization of telehealth, such as the Northern Telehealth Network. This initiative is a consortium of Saskatchewan Health, SaskTel and six Saskatchewan health districts that serve remote and rural communities. The participating health districts include First Nations populations, regional health

<sup>96</sup> RESEARCHANDMARKETS publication quoting a study by HBS Consulting. [www.researchandmarkets.com/reports/28458](http://www.researchandmarkets.com/reports/28458)

<sup>97</sup> RESEARCHANDMARKETS publication quoting a study by HBS Consulting. [www.researchandmarkets.com/reports/28458](http://www.researchandmarkets.com/reports/28458)

<sup>98</sup> [http://www.hc-sc.gc.ca/ohih-bsi/res/init\\_e.html](http://www.hc-sc.gc.ca/ohih-bsi/res/init_e.html)

centres, secondary treatment locations, and an urban tertiary referral and specialist centres. This pilot project recently received assistance from Health Canada which provided \$489,700 that helped fund the necessary equipment<sup>99</sup>. Additional partners for this project include NASA which recently used elements of this system to simulate and test telehealth technologies for astronauts during space travel<sup>100</sup>. This project illustrates the types of funding partnership opportunities that exist in this sector and that Northern Ontario is well-positioned to access. Another example of current telehealth initiatives includes Healthtech Inc. which will be working with the regional health care providers of Northern Ontario to develop an information and communication technology (ICT) plan. This plan will provide a framework for a common regional approach to the implementation of information systems and communications technologies. The project is being led by three District Health Councils (Algoma, Cochrane, Manitoulin and Sudbury; Northwestern Ontario; and Northern Shores).

Northern Ontario's strength in telehealth will be bolstered by the development of the Northern Ontario Medical School (NOMS) which will have a focus on rural healthcare delivery. In addition to the growth in Canadian receptor capacity for telehealth technologies, NOMS will increase the regional receptor capacity.

### ***Regional and Biotechnology Assets to be Leveraged***

There are several assets in Northern Ontario that will assist in the expansion of the local telehealth industries, these include:

- The Northern Ontario Medical School (NOMS) will, in part, focus on rural medicine. This will include the use of telehealth applications and technologies to bring primary healthcare services to remote and under-serviced communities. In addition to being an active user of telecommunications applications and hardware technology for telehealth, NOMS will be an effective platform to both train new healthcare professionals in telehealth technologies and to develop and clinically test new innovations. For instance, NOMS will consist of two, geographically separated campuses. NOMS will utilize various telecommunications applications given the geographic distances that will separate its students and instructors. NOMS will be the catalyst for the increased development and utilization of telemedicine in Northern Ontario and will increase the local receptor capacity.
- Northern Ontario currently boasts the Centre for Rural and Northern Health Research (CRaNHR) which is housed at Laurentian and Lakehead Universities. CRaNHR is a research centre that focuses on the issues pertaining rural healthcare delivery. CRaNHR disseminates research findings to the health care community and uses research and evaluation to support health care decision-makers, planners, providers, and consumers
- The Northern Ontario Remote Telecommunication Health Network (NORTH Network) has been established which provides medical specialists and allied health consultations for patients, and continuing health education for health professionals in rural areas of Ontario. The NORTH Network connects over 70

---

<sup>99</sup> [http://www.hc-sc.gc.ca/ohih-bsi/about\\_apropos/hihsp/comp\\_award/telehealth-infrastructure\\_e.html](http://www.hc-sc.gc.ca/ohih-bsi/about_apropos/hihsp/comp_award/telehealth-infrastructure_e.html)

<sup>100</sup> CMAJ 2000;163(11):1491

sites in Northern and Southern Ontario as well as the Winnipeg Health Sciences Centre in Manitoba. This project's goal is to provide a number of isolated regions and First Nations communities with improved access to care in over 30 medical specialties. Recently, the Thunder Bay Regional Health Sciences Centre implemented a computer radiography telehealth initiative in eight hospitals and two nursing stations. This initiative will permit digital images, patient records and other data to be immediately accessible by medical specialists. Sunnybrook and Women's College Health Sciences Centre and FedNor are important partners in this initiative. North Bay General Hospital was the first Northern hospital in Canada to utilize Telestroke, one of Ontario's newest telemedicine programs. The system operates through a virtual private network, diagnostic-imaging software and two-way video conferencing equipment operated by North Network; a provider of medical specialist consultations for patients in rural areas of Ontario.

- A converge of technologies between industrial robotics and medical robotics is possible. The mining industry has historically been a leader in developing robotics for industrial applications. Given the concentration of mining research in Sudbury, there are local research initiatives in robotics that can be leveraged into health applications. For instance, Penguin ASI is committed to the development and commercialization of teleoperation and robotics. The company's founder, Dr. Gregory Baiden, a professor at Laurentian University and Canada's only Canada Research Chair in Robotics and Mine Automation, bringing significant expertise the region. Dr. Baiden has expressed an interest in exploring medical applications for his technologies.
- Northern Ontario possesses the necessary infrastructure to support the continued expansion of telehealth initiatives. For instance, all universities and colleges in Northern Ontario are serviced by the ORION optical network and Canarie which could be used to electronically link the various academic and health centres (see section 1.7). ORION is the largest fully-owned Research & Education network in the world. This Ultra-Broadband Network links all Colleges, Universities, and Research Centres across Ontario and enables greater research and education productivity by removing bandwidth as a constraint. Other examples of large scale data management infrastructure include the SNOlab (section 1.6.5).
- In addition, the recent and rapid growth in the "call centre" industry across Northern Ontario has created a critical mass in the region that includes information technology professionals, data-entry professionals, database managers and others. The call centre industry has created 8,000 new jobs since the year 2000 in a number of Northern Ontario communities. Northern Ontario is now on the 'radar screen' of call centre industry and communities are receiving numerous proposals from industry for new investment. Call centres represent a significant economic development opportunity for many northern communities. One example would be Sault Ste. Marie which now has more than 2,500 employees in this growing industry<sup>101</sup>. Other examples include Clinidata which is the largest provider of telephone triage and health information services in Canada and employs over 350 registered nurses and has facilities in North Bay

---

<sup>101</sup> Business (published by the National Post), May 2004, 57-67.

and Sudbury, among others. Additional, healthcare related examples within the call centre industry includes new Canadian Blood Services national call centre which has created 150 new jobs in the Sudbury area.

- The Group Health Centre, located in Sault Ste Marie is the largest primary care disease site registry in Canada consisting of 58,000 patients. The centre has partnered with several initiatives in the Province, including the Sault Ste. Marie Innovation centre, McMaster University and with CRaNHR in Sudbury on a recent telehealth study. Building on this foundation, a comprehensive, community and family medicine-based medical research database could be developed in Sault Ste. Marie. The existing high speed, telecommunication infrastructure, database and server capacity, information technology expertise, and biotechnology partnerships established in Sault Ste. Marie make it a logical choice to support a data warehouse of this magnitude.
- Northern Ontario has a successful track record in developing collaborations within the information technology sector. For instance, CONTACT North is a globally recognized leader in telecommunications and distance education. CONTACT North maintains connections at over 145 sites and is an excellent example of a successful public-private partnership in the high tech sector<sup>102</sup>. Another excellent example is Lakehead University's "Smart Classrooms" which are used for the "e-education" program. This state of the art teaching environment is located in the new Advanced Technology and Academic Centre (ATAC) and was developed with support from Anixter Canada, Bell Canada, IBM Canada Ltd., Nortel Networks, Precision Camera Inc., SGI, Sony Canada, and Sun Microsystems of Canada<sup>103</sup>.
- Two North Bay Surgeons, Drs. McKinley and Hegge, have spent three years developing the largest case experience in Northeastern Ontario for minimally invasive surgery and have completed the first telerobotics surgery in Northern Ontario at North Bay General Hospital.

### **Business Concept**

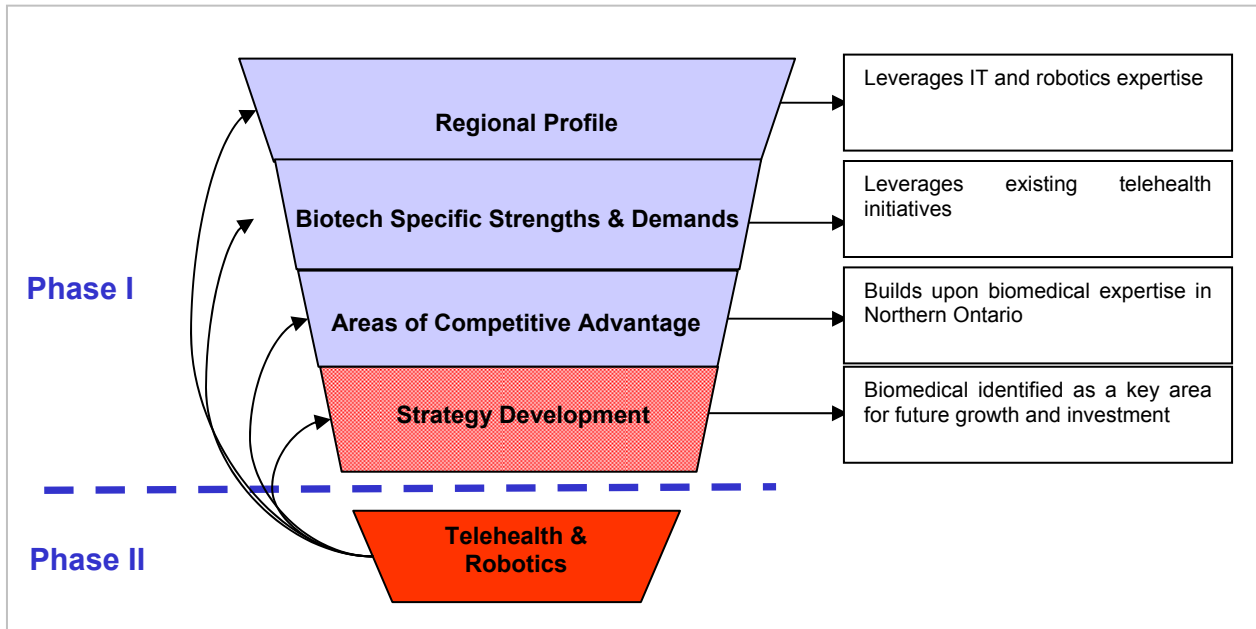
The development of various commercial opportunities within the telehealth sector is directly aligned with Ontario's *Public Health and the Environment* biotechnology subcluster. Northern Ontario is an important partner within this subcluster and the region contributes the requirements (i.e. receptor capacity) to locally adopt and test innovations for the application and delivery of telehealth. Therefore, Northern Ontario is positioned to be an important partner in the development of telehealth technologies within the provincial subcluster. In addition to the growing number of opportunities to develop industry partnerships there is also an expansion in the number of public and not-for-profit opportunities for investment in telehealth. For instance, the Canada Health Infoway Inc. (CHII) is an independent, not-for-profit corporation that was established with a \$500 million investment by the Government of Canada. CHII is intended to be a facilitator and strategic investor, not a granting body. CHII's Board consists of the Federal, Provincial, and Territorial First Ministers of Health who, in September 2000, agreed to "work together to strengthen a Canadawide health info-structure to improve the quality, access, and timeliness of healthcare for Canadians." The mandate of CHII is

---

<sup>102</sup> <http://www.cnorth.edu.on.ca>

<sup>103</sup> Lakehead University Magazine, 2004, vol.21(1):8.

to accelerate the development and adoption of electronic health information systems with compatible standards and technologies across Canada. This mandate is aligned with Northern Ontario's interests in continuing to develop and implement telehealth methods throughout the region. It is anticipated that support for this proposal would be obtained from CHII, Health Canada, and other federal programs. NOBI represents an excellent portal to identify and foster strategic partnerships with industry and other regions of Ontario in telehealth. The diagram below outlines the alignment of this telehealth initiative with the overall BCIP process that was undertaken for Northern Ontario.



### Steps to Move Forward

#### Step 1: Inventory and Linkage of Regional Assets

- Maintenance of an up-to-date inventory of the telehealth assets, ongoing projects and related and convergent technologies and expertise
- Develop an understanding of the local healthcare needs and that could be addressed via telehealth, this includes developing partnerships with various local communities (i.e. rural districts, First Nations, etc.)
- The biomedical specialist of NOBI will contact the regional organizations to be leveraged and will solicit their involvement and participation in the development of potential telehealth projects in Northern Ontario
- Further definition of Northern Ontario's unique and competitive advantage in telehealth initiatives

#### Step 2: Partnership Development and Market Analysis

- Identification of collaborative opportunities within Ontario's *Public Health and the Environment* biotechnology subcluster
- Identification of national and international expertise and technologies that could be applied locally
- The biomedical specialist of NOBI will disseminate knowledge regarding the telehealth opportunities in Northern Ontario

- Roll out marketing and business development strategy to become recognized as Canada’s national demonstration site to test and develop telehealth technologies

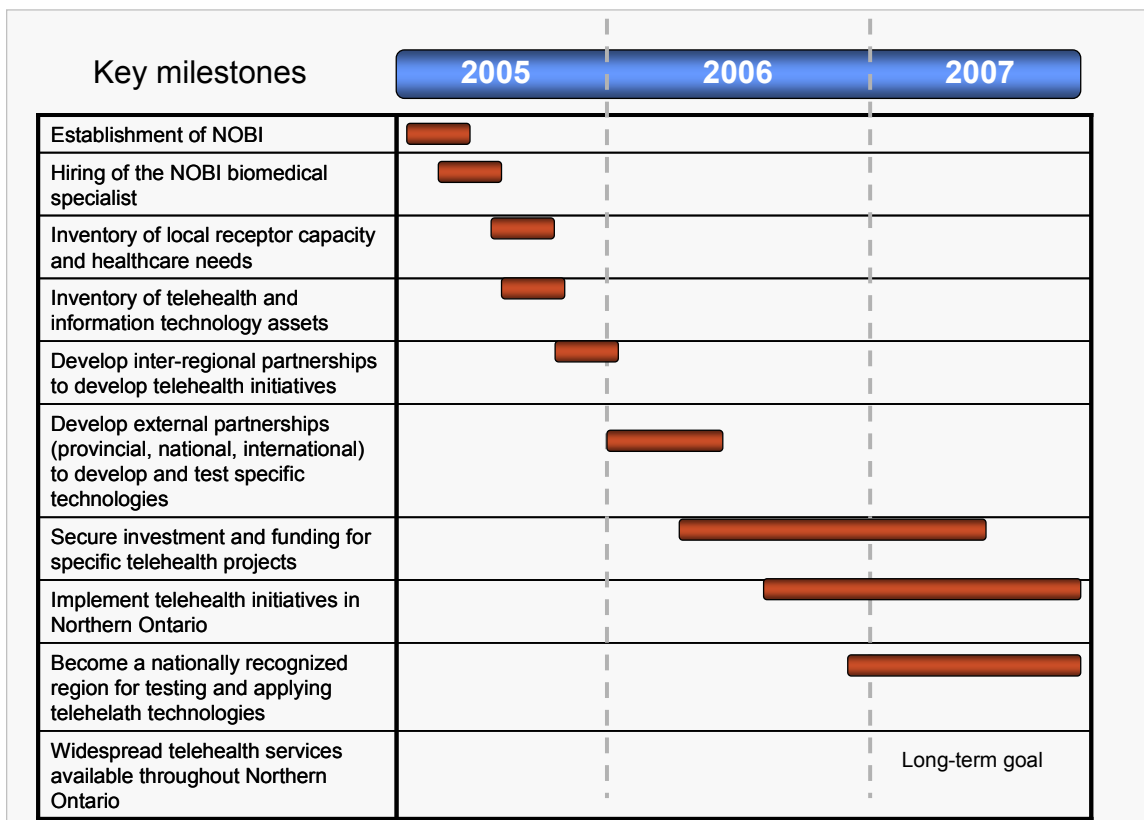
**Step 3: Pilot Projects on Networked Infrastructure**

- Identify specific partners and develop pilot projects that could be implemented locally
- Develop and initiate capital sourcing activities to support specific projects and opportunities
- Attract, train and retain the necessary highly qualified personnel throughout Northern Ontario that can build and implement telehealth service networks
- Continually expand the telehealth resources and infrastructure located in Northern Ontario which can service as both a testing platform for new innovations and as a service provision platform

**Step 4: Service Expansion and Delivery**

- The long-term goals of these project are to provide the highest quality of care to the residents of Northern Ontario in a cost-effective manner
- Develop of an extensive telehealth network that services remote communities and links patients and doctors in Northern Ontario to specialists located throughout the Province
- Development of tele-robotics surgical suites within Northern Ontario to expand the scope of medical treatments offered within the communities of Northern Ontario

**Timelines and Milestones**



### 3.11.5 Biomining and Bioremediation

#### Overview

Northern Ontario has an opportunity to increase its international profile in the areas of biomining and bioremediation. A feasibility analysis will be required in consultation with the mining industry in Northern Ontario in order to determine the potential receptor capacity for these technologies. Initially, an opportunity has been identified to obtain research funding for the establishment of a biomining and bioremediation research laboratory at Laurentian University by leveraging the assets and research strengths that already exist.

#### Background

Biomining bacteria, such as *Acidithiobacillus ferrooxidans*, *Thiobacillus caldus* and *Leptospirillum ferrooxidans*, are used in the recovery of metals from ores in a process called bioleaching or biooxidation. These bacteria have an unusual physiology in that they obtain their carbon by fixing carbon dioxide and their energy from the oxidation of either ferrous iron or reduced sulphur compounds. The sulphuric acid produced when growing on sulfur lowers the pH of their environment to pH1.5-1.8.

There are two main types of processes for commercial scale biomining:

1. Irrigation-type processes involve the percolation of leaching solutions through crushed ore or concentrates that have been stacked in columns, heaps or dumps. Copper is one of the most commonly mined minerals from irrigation-type biomining operations. For example, dump leaching has been conducted at the Kennecott Copper mine in Bingham Canyon, Utah since the late 1960s<sup>104</sup>.
2. Stirred tank-type processes involve continuously operating, highly aerated tank reactors that are typically arranged in series. This process is typically applied in the extraction of gold.

**Case Study:** In situ bioleaching was applied in Northern Ontario in the extraction of uranium from Denison's Elliot Lake operation. In this process underground ore was fractured and flooded with acid mine drainage liquor. After 3 weeks, this liquor was drained and pumped to the surface where the uranium was extracted. In 1988, approximately 300 tonnes of uranium were recovered using this process.

Utilizing bacteria in the recovery of ore has a number of distinct advantages over traditional mining practices. Microbial extraction does not require high amounts of energy and does not produce harmful emissions, such as sulfur dioxide. Biomining is particularly applicable in the extraction of metals from certain low quality ores. For example, copper can be recovered from low grade ores and dumps left behind from previous mining operations.

Biomining processes are strongly influenced by temperature, with different organisms being most active at different temperature ranges. Most biomining occurs in the 20 to 35°C range and tanks can be used to control this temperature for the processing.

<sup>104</sup> Rawlings, D.E. Heavy Metal Mining Using Microbes. Annu. Rev. Microbiol. 2002. 56:65-91.



However, information gaps exist with regard to the dominant biomining organisms for lower temperature ranges. Also, processes for operating biomining operations in lower temperatures have not been developed.

Bioremediation is the use of biological systems, generally microorganisms and plants, for the reduction of pollution from air or from aquatic or terrestrial systems. Some applications of bioremediation are: waste water and industrial effluents, drinking and process water, air and waste gases, soil and land treatment and solid waste.

### **Regional and Biotechnology Assets to be Leveraged**

Northern Ontario has significant mining infrastructure and assets, but currently has limited activity in the area of biomining.

- Widespread shallow mineral assets in Northern Ontario may be good candidates for utilization of biomining technology.
- Northern Ontario's leadership position in mining technology is an opportunity for expansion of these technology assets into the areas of biomining and bioremediation.
- Dr. Gregory Baiden, of Laurentian University, has received a donation of equipment for a biomining lab, but does not currently have infrastructure funding to establish this research facility.
- Drs. Leo Leduc and G.D. Ferroni, of Laurentian University, are active in the field of Microbiology of iron-oxidizing bacteria. Their seminal contribution to the field of biomining is the site specificity of *Acidithiobacillus ferrooxidans* strains.
- Drs. Catalan, Lionel and Liao, Baoqiang of Laurentian University are funded by NSERC and are performing research relevant to industrial waste management and remediation.
- The Mining Innovation, Rehabilitation and Applied Research Corporation (MIRARCO) is another potential asset and partner in biomining and bioremediation initiatives.

**Case Study:** Canada has several prominent biomining researchers that could contribute to the proposed biomining initiative; these include Richard Lawrence, Albert Bruynesteyn (Vancouver) and Brad Marchant (BioteQ, a Canadian sulphur processing company, P.B. Marchant Inc.) V.L. Lakshmanan (Toronto), Gould (CANMET), and SGS Lakefield Research Inc. Other active Canadian biomining companies include BakTek and GeoBiotics.

In Canada, P.B. Marchant Inc. has conducted a pilot scale of bioleaching for Equity Silver Mines. Additional projects include the bacterial destruction of cyanide by bacteria in Northern Quebec and Ontario which is being performed by CANMET.

Globally, Ghana, Brazil, South Africa and Australia are the countries that have invested heavily in the research and practice of biomining (gold mining). In the USA, J.A. Brierley has been actively involved in biomining for several decades. Some of the major current biomining plants (gold mining) in the world are: Vaal Reefs and Fairview in South Africa, Sao Bento in Brazil, Harbour Lights and Wiluna in Australia, and Ashanti in Ghana. There is also active biomining of copper and uranium at various locations throughout the world.

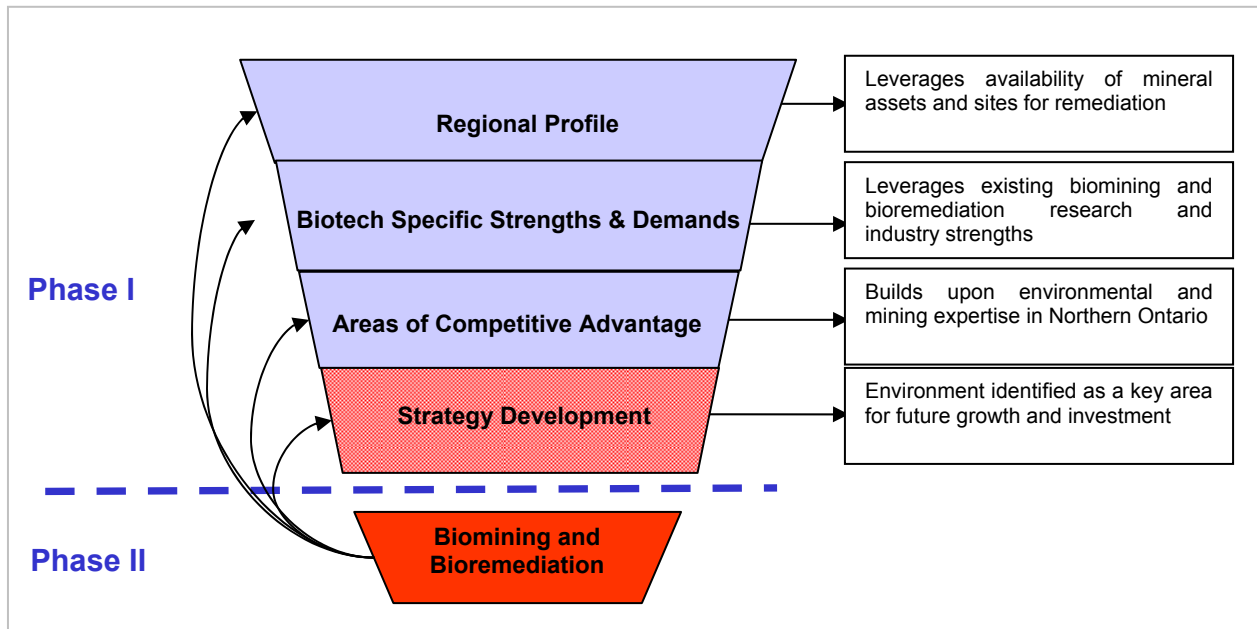
*Source: W.T.(Tai) YEN, Emeritus Professor of Mineral Processing and Gold Extraction, Department of Mining Engineering, Queen's University, Canada*

MIRARCO is a not-for-profit applied research and technical service collaboration between Laurentian University and the private and public sectors.

**Business Concept**

This business case will be integrated into Ontario’s *Public Health and the Environment* subcluster. This initiative is focused on adapting proven technologies for use in Northern Ontario. These technologies will reduce the environmental impact of industrial mining operations and are therefore of both regional and Provincial benefit. Ontario’s mining industry is committed to investment in environmental and in bioremediation efforts. In fiscal 2001, the Ontario mining industry spent \$55 million on environmental protection, improvement and prevention<sup>105</sup>. The industry is therefore an important receptor of innovation as it is able to sustain significant capital investments. For example, approximately \$1 billion was spent during the 1990s in Sudbury for sulphur dioxide abatement programs.

Biomining is a mineral extraction technique that would significantly reduce environmental impact. In addition, to benefiting the local mining and environmental technologies companies in Northern Ontario, there will also be potential out-licensing opportunities as new processes and technologies are developed. Northern Ontario, home to Ontario’s mining industry, possesses the regional capacity to adopt and utilize biomining innovations. Opportunities in biomining were identified for Northern Ontario throughout the Biotechnology Cluster Innovation Program (BCIP). A biomining initiative builds on the traditional, industrial strengths of Northern Ontario and will also link many of the regional biotechnology assets. The alignment of this biomining business concept within the BCIP process is outlined below.



<sup>105</sup> Institute for Policy Analysis, 2002 “The Economic and Fiscal Contribution of the Mining Industry in Ontario”

### **Steps to Move Forward**

The biomining and bioremediation initiative will be further explored by the environment specialist of NOBI. Initially the specialist will focus on developing industry and community interest and participation. Once specific projects and partnerships have been developed, the next step will be to obtaining research funding for the establishment of a biomining and bioremediation research facility at Laurentian University, and on consultation with the mining industry in order to better understand the local receptor capacity for this technology. These steps are outlined below.

#### **Step 1: Industry Outreach**

- Identify the industry players (MNEs and SMEs) that could become stakeholders, partners, investors or otherwise participants in a biomining initiative
- Understand the industry needs and climate to adopt innovation, regional research assets and environmental issues pertaining the mining sector
- Develop linkages and partnerships with industry for a biomining initiative
- Building upon the key research strengths in the region, identify the “first-win” projects that have the greatest commercial potential within a 2-5 yr timeline
- Inventory the current research assets and expertise and identify the gaps and areas for targeted investment
- Inventory the shallow mineral assets in the region that are suitable for biomining

**Case Study:** Toronto-based BacTech Mining Corporation owns proprietary bacterial oxidation technology that liberates precious and base metals from difficult to treat sulphides ores and concentrates. The advantages of this technology include improving metal recovery at significantly lower capital and operating costs when compared to traditional treatment methods of smelting, roasting and pressure oxidation. BacTech has successfully commercialized its technology in the metal extractive industry. Due to the requirement for automation in biomining processes, BacTech has developed a strong informal and business relationship with Penguin Automated Systems Inc. of Sudbury. Penguin has provided process engineering, process operating cost and capital cost estimates for BacTech’s Tonkin Springs Gold Mine Project in north-central Nevada.

#### **Step 2: Capital Sourcing**

Following the identification of the partners and of the project details, an investment grade business plan will be developed and used to secure investment. Potential funding sources include:

- Provincial: BCIP, Ontario Innovation Trust, ORDCF, NOHFC
- Federal: NSERC, CFI, Industry Canada, Environment Canada, FedNor
- Academic and research partnerships: (i.e. Laurentian University, MIRARCO and other research centres throughout the Province may become partners)
- Private sector: various sector companies would be interested

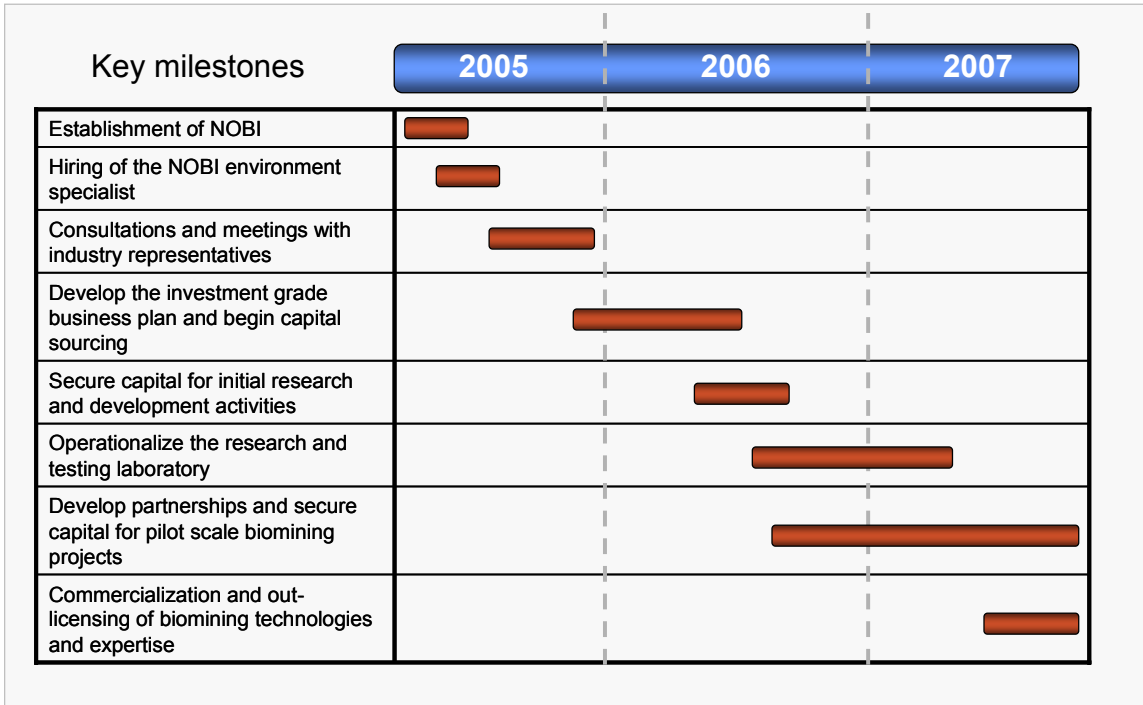
#### **Step 3: Establish the Research Program at Laurentian University**

Once the capital and partnerships are in place, the biomining and bioremediation research laboratory will be established at the University of Laurentian. This Step will involve developing the required infrastructure, training and attracting the highly qualified personnel and other administrative functions.

**Step 4: Implementation of Pilot Scale Projects (Technology Demonstration)**

The Step will develop the industry partnerships and agreements that will initiate projects to test specific technologies and methods for biomining.

**Timelines and Milestones**



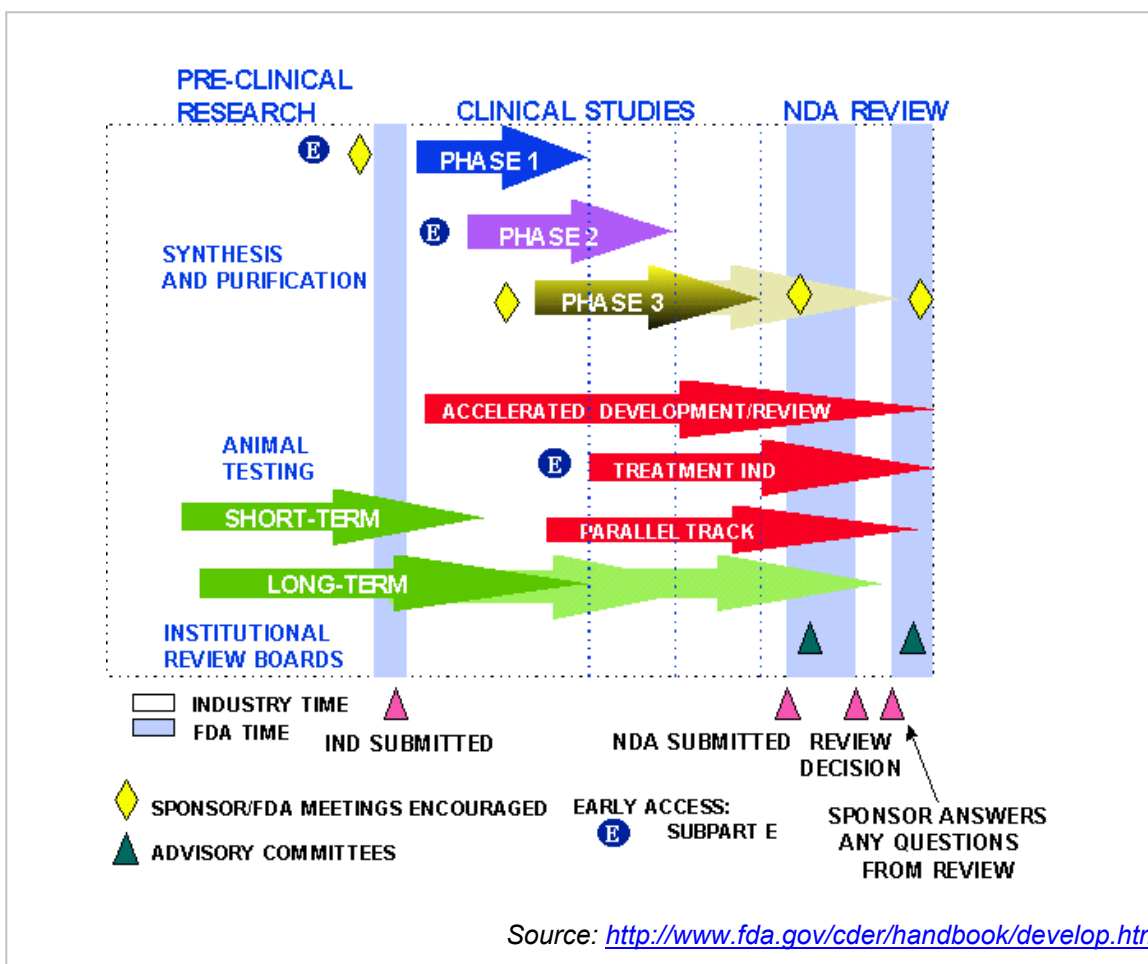
### **3.11.6 Not-For-Profit Phase 1 Clinical Research Organization**

#### **Overview**

Northern Ontario is well positioned to play an important role in Ontario's Provincial strategy in *Clinical Trials and Healthcare Services* through the development of a not-for-profit, Phase 1 clinical research organization (CRO). The vast majority of CROs both within Canada and globally operate on a for-profit basis, however the not-for-profit model has several unique advantages. Northern Ontario has many clinical research assets that could be leveraged in the creation of such an organization. Further expansion of current clinical trial activities into Phase 1 will assist in the growth of all clinical trial activity in Northern Ontario.

#### **Background**

Clinical trials represent a critical milestone in the drug development process. In the first phase (Phase 1) of a clinical trial, researchers test a new drug or treatment in a small group of healthy people (20 - 80) for the first time to evaluate its safety, determine a safe dosage range, and identify side effects. Phase I trials are carried out within a dedicated trial facility or academic centre/hospital as close monitoring of volunteers is required. As Phase 1 is the first time a drug is tested in human volunteers, it is extremely important to have an experienced staff and access to the necessary monitoring and medical equipment. Phase 1 clinical studies determine the metabolic and pharmacologic actions of the drug in humans, the side effects associated with increasing doses, and, if possible, to gain early evidence on effectiveness. The drug development process is diagrammed below.



As the costs of clinical trials have increased, biopharmaceutical companies often look to clinical research organizations (CROs) as an outsourcing alternative that can be both rapid and cost-effective. The CRO industry has evolved to a full-service industry that encompasses the entire drug development process, including preclinical evaluations, study design, clinical trial management, data collection, biostatistical analysis, and completing product regulatory requirements. Typically, CROs compete on the basis of specific therapeutic expertise, and the proven ability to recruit principal investigators, and patients into studies.

**Case Study:** Ventana Clinical Research Corporation is a CRO operating in Toronto and located to serve the University of Toronto and the various research and teaching hospitals within Toronto's Downtown Hospital corridor. Ventana operates a 16 bed facility and currently has Phase I, II and III trial capacity. In addition, Ventana boasts access to one of the world's most ethnically diverse populations that can reduce recruitment timelines for specialized trials.

The CRO will assume the responsibility for getting the trial approved by an Institutional Review Board (IRB), which is often located at the affiliated hospital or academic centre. The Review Board addresses and assures that the trial falls within the established ethical guidelines pertaining to working with human participants. The IRBs approve the

study protocol, the informed consent procedures, and some other aspects of the trial, oftentimes including the compensation paid to patients. When the trial is based at a hospital or academic institution, that organization's IRB will approve and oversee the trial, but when a CRO conducts the trial, it will generally use an independent and professional IRB to perform this service. The not-for-profit model may have an advantage in gaining approval from the internal review board (IRB) to proceed with the trial as it will operate at a greater "arms-length" from the economic considerations.

A not-for-profit Phase 1 CRO will be in an advantageous position to develop joint initiatives with both industry and government partners in the development of new drugs and treatments. For example, the Canadian Institute for Health Research (CIHR) is committing greater resources to clinical trials and there is general trend towards a greater commitment to "proof-of-principle" and translational research. The not-for-profit model represents an excellent bridge between the private and public sectors and will allow opportunities to leverage public funds.

### ***Regional and Biotechnology Assets to be Leveraged***

There are several clinical research assets located throughout Northern Ontario that would be partnered within this initiative. The major assets include:

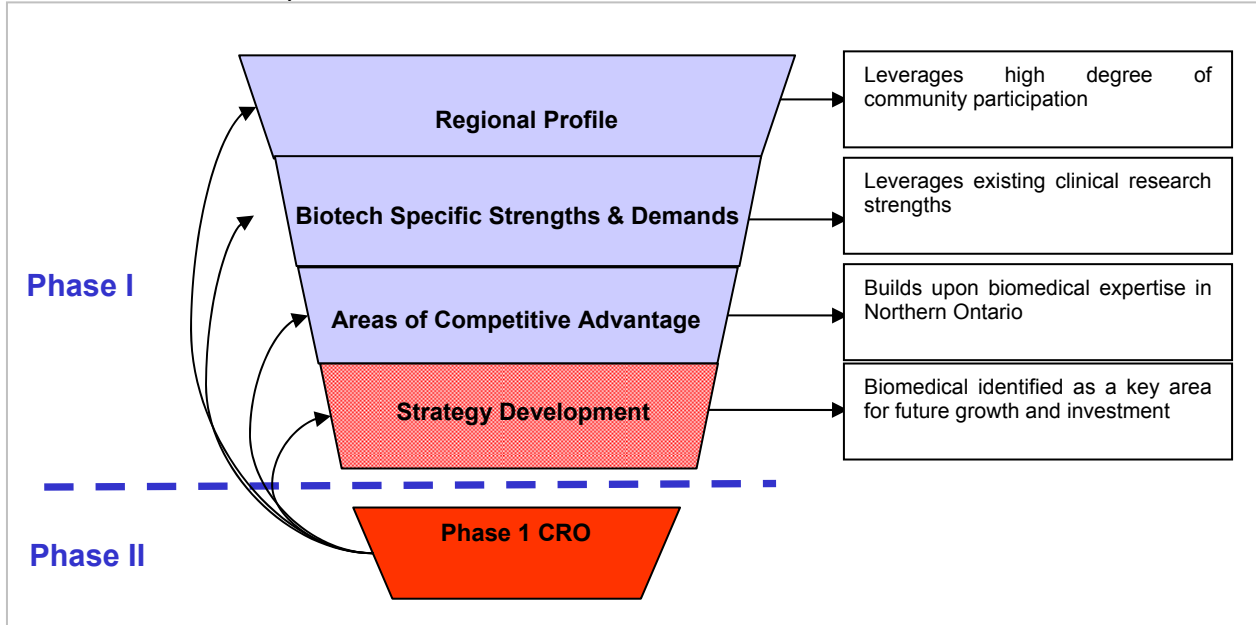
- The Northern Centre for Biotechnology and Clinical Research (NEUREKA!) is an important asset for Northern Ontario. It currently operates as a CRO and has expanded rapidly, including a head office in Sudbury and satellite offices in Timmins, North Bay, Thunder Bay, Sault Ste. Marie and Oakville. In addition, to expanding its physical presence, NEUREKA! has also grown its clinical trial capacity and has completed to-date over 84 clinical trials for over 70 pharmaceutical companies. NEUREKA! is uniquely positioned to offer Phase I clinical trials within a not-for-profit business model as an expansion of its current business model. The attraction of Phase 1 trials to the region would help to encourage and grow the activity clinical trial activity of NEUREKA!
- The Group Health Centre (GHC) in Sault Ste. Marie is also a key asset for Northern Ontario in clinical trials. GHC has been conducting clinical trials since 1980, and currently has a comprehensive medical data base for its 58,000 patients. This asset in clinical trials could be leveraged in the establishment of a not-for-profit Phase 1 CRO.
- Other clinical trial assets within Northern Ontario include both the Northeastern and Northwestern Regional Cancer Centres. These organizations are currently actively involved in clinical trials in Phases 1 through 3. As well, the newly established Northern Ontario Medical School (NOMS) will be a key clinical asset for the region.
- North Bay has a number of clinical trial assets including the Northgate Medical Clinic, ProBity Medical Research, and North Bay Research.

### ***Business Concept***

Much of the required infrastructure and preliminary assets for a Phase 1 CRO is currently in place within Northern Ontario, as outlined above. This proposal describes some of the internal and external regional linkages that could be leveraged to form a not-

for-profit Phase 1 clinical trial organization. The not-for-profit model for this organization increases the number of potential capital sources that can be accessed. For instance, this not-for-profit business model may be viewed favourably from other not-for-profit organizations (i.e. charities and foundations) that invest in health research.

This business model will benefit greatly from the exposure and networking opportunities provided by the linkages between NOBI and MaRS (Toronto). NOBI will link the proposed Phase 1 CRO to the existing clinical trial networks located in Toronto and throughout Southern Ontario. The figure below outlines the alignment of this initiative with the overall BCIP process.



### Steps to Move Forward

The proposed Phase I clinical trial initiative is directly aligned with Ontario's subcluster strategy in *Clinical Trials and Health Services*. Importantly, NOBI will serve as the link for this initiative to play an important role, in parallel, with the ongoing clinical trial activities in Toronto and Hamilton, among other regions. The key steps to implementing the proposed, not-for-profit, Phase I clinical trial organization are outlined below.

#### Step 1: Linkage of Regional Assets

- The biomedical specialist of NOBI will contact the regional organizations to be leveraged for this initiative (described above) and will solicit their involvement and participation in the development of the proposed Phase I clinical trial organization
- The leadership roles and the various responsibilities and tasks of the regional stakeholders will be defined, this will include identifying the various partnership and collaborative opportunities
- Throughout this step, key strengths of the region will be further identified and inventoried, additionally, key gaps will be identified which will represent opportunities for external partnerships and collaborations

#### Step 2: Partnership Development



- Identification of collaborative opportunities within Ontario’s clinical trial network (i.e. within Ontario’s *Clinical Trials and Health Services* subcluster)
- Development of memorandums of understanding (MOUs) with the various regional partners and with the other assets within the Province

**Step 3: Market Analysis**

- Define the customer base for the Phase 1 CRO services
- Perform a detailed market assessment (i.e. understanding the market demand)
- Outline the regional competitive advantages to establish this facility
- Outline the competitive advantages of a not-for-profit Phase 1 CRO

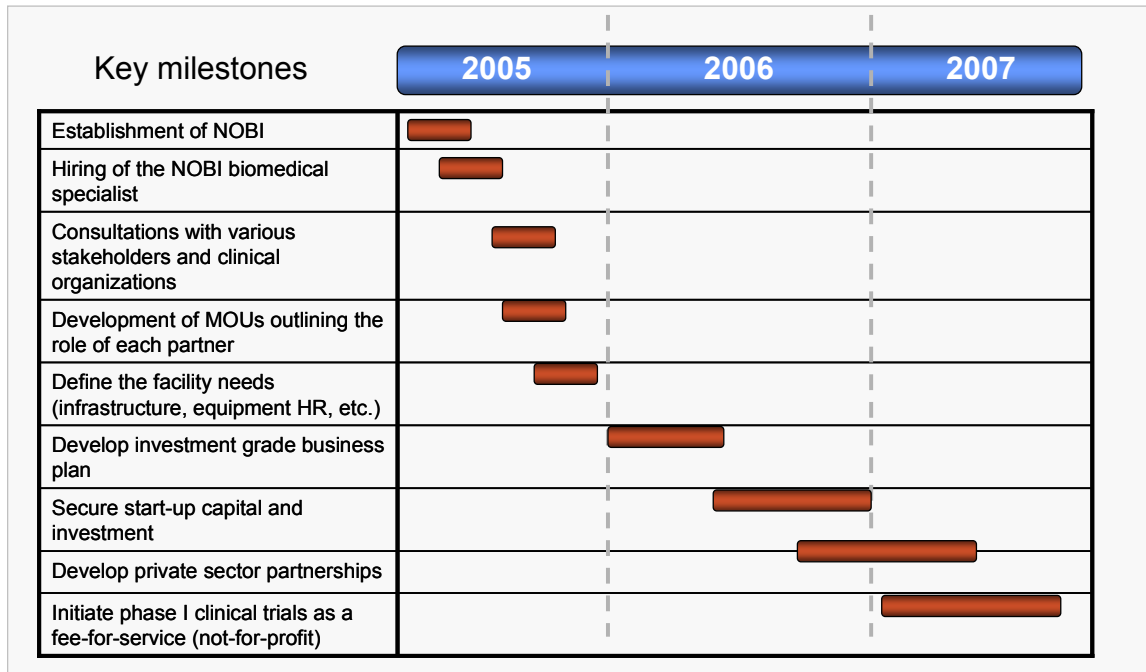
**Step 4: Development of the Investment Grade Business Plan**

- Assessment of the facility requirements including expertise, infrastructure, equipment, human resources, etc.
- Perform benchmarking and identification of best-practices for clinical trial CROs (specific to Phase 1)
- Definition of the organizational and governance models
- Development of a pro forma financial analysis and definition of revenue and investment sources

**Step 5: Implementation**

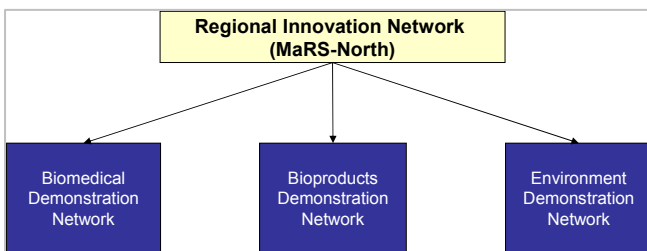
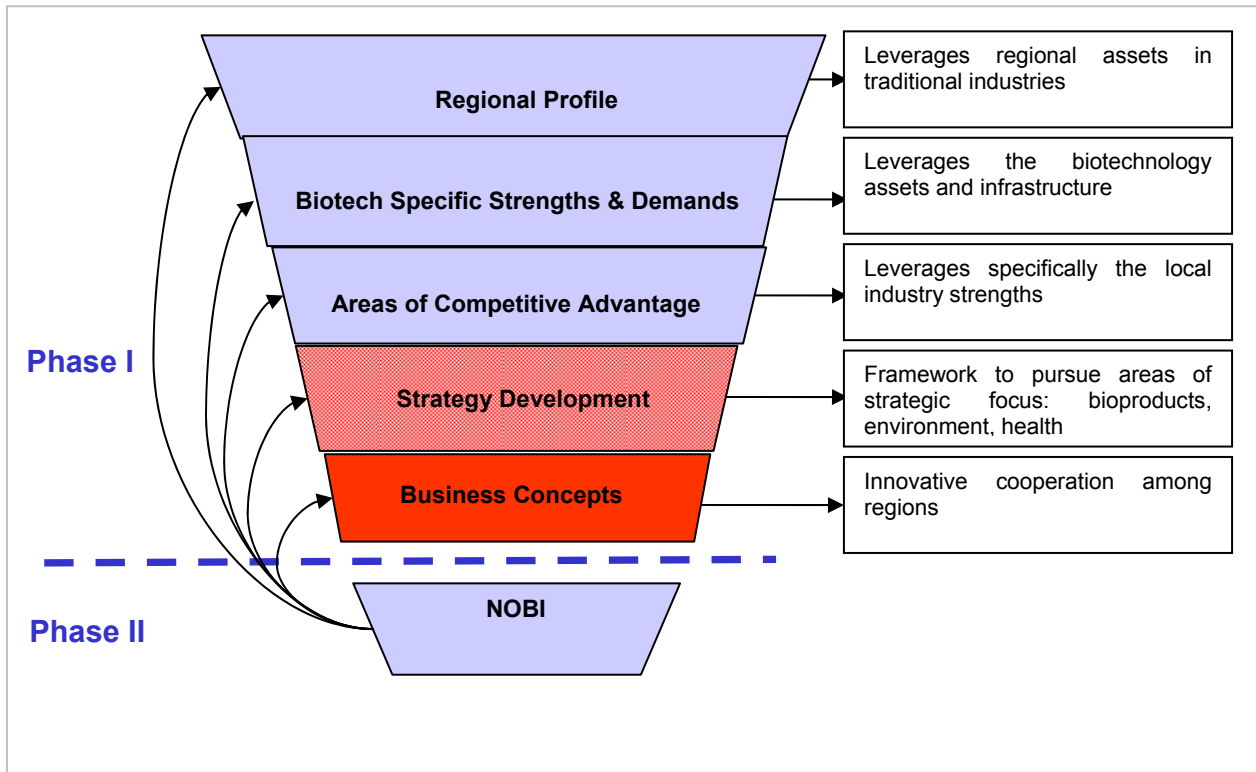
- Actively pursue capital sourcing opportunities
- Hire required personnel and source needed equipment
- Roll-out business development strategy (via NOBI) and initiate client interactions

**Timelines and Milestones**



### 3.12 Conclusions and Next Steps

NOBI will leverage the existing assets across Northern Ontario into a unified voice to promote biotechnology. It will fully leverage the Provincial investments that have been made into MaRS Discovery District and allow for greater interactivity between Northern and Southern Ontario.



In addition to developing a business plan for NOBI, the NOBI is developing three proposals that focus upon one of the key strengths for the region, namely, forestry, mining and health. These proposals are currently under development with the assistance of sector specific

subcommittees that are composed of regional stakeholders and subject matter experts. The subcommittees have maintained a heavy emphasis on industry representation. Each of these proposed projects will be linked to the NOBI Network to ensure coordination through the region. These proposals are described as a high level outlines and are for consideration within the selected “subclusters” of the BCIP program. A future activity of NOBI will be to further develop these documents into investment grade business cases that can then be used to attract capital.

# Appendix 1 Existing economic development plans

## **North Bay/Nipissing/Muskoka**

North Bay Economic Development Department, BUSINESS PLAN, Mission Statement: Job Creation and Retention, Enhancement of Quality of Life and Prosperity. Available upon request from the Mayor's Office of Economic Development  
[annemarie.rhindress@cityofnorthbay.ca](mailto:annemarie.rhindress@cityofnorthbay.ca)

## **Sudbury/Manitoulin/Parry Sound**

A copy of Sudbury's strategic plan can be found at:  
<http://www.city.greatersudbury.on.ca/content/econdev/documents/GSDCStrategicPlanJune162003.pdf>

## **Sault Ste. Marie/Algoma**

Economic development/innovation plans developed in the Sault Ste. Marie and Algoma Region within the last 3 years are listed in the following citations.  
2002 Annual Report, Superior East Community Futures Development Corporation  
[http://www.superioreast.on.ca/business\\_plan.htm](http://www.superioreast.on.ca/business_plan.htm)  
Contact: Phone: 705-856-1105 or 1-800-387-5776

- Blind River Development Corporation & BRITE Centre Strategic Plan Summary  
<http://www.blindriver.ca/blindriver/ced/publications/strat03.pdf>  
Contact: Phone: 705-356-1152
- DESTINY Sault Ste. Marie, Sault Ste. Marie Economic Diversification Strategy  
[www.cityssm.on.ca/eng/plan/eds/ssmeds.htm](http://www.cityssm.on.ca/eng/plan/eds/ssmeds.htm)  
Contact: Mr. Bill Therriault, Managing Director, 705-759-2664
- ULERN Strategic Plan  
[http://www.ulern.on.ca/pdf\\_files/strategicplan0903.pdf](http://www.ulern.on.ca/pdf_files/strategicplan0903.pdf)  
Contact: Sharon Cuddy, 705-759-2554 ext. 540

## **Thunder Bay/Northwestern Ontario**

An abbreviated version of the strategic plan is provided for Thunder Bay/Northwestern Ontario, the entire plan is appended to the regional innovation profile developed for this region.

The Tourism & Economic Development Division has the lead responsibility in the Corporation for tourism and economic development initiatives. The following business plan is the Division's strategy in undertaking and implementing this responsibility.

Mission Statement:

To promote and encourage a climate for increased economic opportunities and establish Thunder Bay as a premier vacation destination and gateway to the tourism experiences of the region.

Building on Success:

In our efforts to create the new Division we will also be building on past successes. The Forestry Centre of Excellence project eventually led to the creation of Forestry Thunder Bay. This approach of involving the community in our economic development planning will continue, especially with the creation of advisory teams. Both Tourism Thunder Bay and Development Thunder Bay have been known for excellent customer service. We will build upon those successes and introduce a formal Customer Relations Management program. Giant Step II identified the need for new product development, which led to the development of seasonal packages that have been widely recognized as successful, including winning an Economic Development Council of Ontario (EDCO) award. In the new organization there will now actually be one position completely dedicated to tourism product development. Furthermore, this position will be an Economic Development Officer so that the importance of tourism is recognized within the new Division.

There are many new opportunities to explore with the new Division. However, it must be acknowledged that both Tourism Thunder Bay and Development Thunder Bay had initiatives that were recognized, sometimes Canada wide, for their success. The new structure attempts to enhance Administration's ability to focus on those successes as well as the new opportunities that lay before us. The philosophy was to keep the best and throw out the rest.

Situational Assessment:

1. The assessment base and population are declining, but there is a desire and commitment from the community and City Council to turn things around.
2. Stakeholder expectation on the quality, quantity and delivery of service is increasing as technological improvements change how we do business.
3. The new Division is the result of the combination of the Tourism Division and the external organization Development Thunder Bay, and is now part of the new Development Department.

Competing priorities within the Corporation for resources that have become increasingly constrained.

The general public has not been completely informed of the services and accomplishments of neither the former Tourism Thunder Bay nor Development Thunder Bay.

6. New opportunities for economic diversification have developed, including the creation of the Northern Ontario Medical School.
7. Thunder Bay has a strong and globally competitive position in forestry and transportation.

A New Division with a Flat Structure:

The objective of this new business plan is to integrate Tourism Thunder Bay and

Development Thunder Bay so as to exploit all possible synergies. The result is an entirely new Division, as opposed to a Division with a tourism unit and economic development unit.

The Division has been deliberately organized to have a very flat structure. The number of managers in the Division has been reduced from two to one. All other staff are frontline staff, though one of these positions also supervises the travel counsellors in our visitor information centres.

Clusters and Team Based Organization:

Two of the central elements to the reorganization are: a cluster approach and a team-based organization. Clusters have been defined as geographical concentrations of industries that gain performance advantages through co-location. This approach is cutting edge and will help position the economic development strategy of Thunder Bay at the forefront of this field. Urban centres are the economic engines of their regions, and indeed the country. There is a great deal of literature reviewing why this is the case. One of the key reasons is that clusters can form and thrive in urban areas. In order for Thunder Bay to thrive economically, we need to take our top traded-clusters and focus on expanding them to be fully mature and globally competitive. We will need to build these clusters into world-renowned specialized economic foundations. The key principle of the team-based organization is to involve the community in our economic development. The new Tourism & Economic Development Division will accomplish this with bottom up input from advisory teams. These teams will not set policy or provide day-to-day direction for the Division's staff. Instead, their expertise will be used to provide industry intelligence and reveal new opportunities for growth for Thunder Bay.

These two approaches help create a learning organization - an organization that can quickly assimilate new opportunities and adapt to new circumstances.

***The Strategic Centres of the Division***

There are four key units to the new Division: Business Development Centre, Tourism Services Centre, Community Marketing Centre, and the Enterprise Centre.

Business Development Centre:

The Business Development Centre will use a cluster approach to economic development and will have four Economic Development Officers (EDOs). One of Thunder Bay's top four traded-clusters will be assigned to each of these four EDOs. Thunder Bay's top traded-clusters were identified using information from the Institute for Competitiveness and Prosperity. It is important to note that the clusters have been assigned to the EDOs, not visa-versa. This means that each EDO will be expected to also handle other economic development opportunities beyond the existing four clusters. However, they will also be responsible for pro-actively dealing with issues within their assigned clusters. This creates a highly flexible organization in that we can change our target clusters as new opportunities and challenges are identified. A team approach will be used throughout this unit. Each cluster will have an advisory team that will act as an industry resource to the EDO. The four clusters that have been targeted are: forestry, transportation, tourism, and education and knowledge creation.

Thus, this unit will deal with both tourism and economic development issues. Within

each of these clusters we have targetted a particular area for growth: value added (forestry), aviation (transportation), demand generators (tourism), health and biotechnology (education and knowledge creation). The flagship initiatives for each EDO will ideally flow from the cluster assigned to them.

Tourism Services Centre:

The Tourism Services Centre will provide services to visitors, conventioners, the travel trade and media. A team approach will be used for meetings, conventions and incentive travel. This will allow for key stakeholder buy-in to the development of a comprehensive and ongoing strategy for this sector. This is the only unit that will deal almost exclusively with tourism. The Travel Trade & Media Officer will handle all aspects of the travel media. This person will also identify economic development media opportunities but will then turn those over to the appropriate EDO. There is no advisory team associated with this position; however, there will certainly be ad-hoc meetings of tourism stakeholders to create a coordinated approach with the travel media.

Community Marketing Centre:

The Community Marketing Centre will handle all research and marketing initiatives of both our tourism and economic development initiatives. This unit will be responsible for implementing and monitoring a system that tracks all marketing efforts across the Division. The Partnership Marketing Officer will spend most of their time on tourism marketing but will also be responsible for advertising related to other economic development initiatives. The Information Officer will be responsible for handling research for all four of our target clusters.

Enterprise Centre:

At present the Enterprise Centre is operating as a Business Self-Help Office. One of the objectives for 2003 will be to officially expand this into an Enterprise Centre. It will then focus on providing support to small local businesses in their start-up and expansion attempts. The staff person in this area will also be an Economic Development Officer. While the EDOs in the Business Development Centre will concentrate on four distinct clusters, this EDO will cut across all of these and more in order to provide support for these new and start-up businesses. There will also be a focus on small business retention. An advisory team of partners, business organizations and successful entrepreneurs will be established to help guide this unit.

Advisory Teams and Flagship Initiatives:

The advisory teams within each centre will not guide the day-to-day activities of the staff. They are there as a resource to provide industry intelligence, feedback and ideas. There will be no more than 14 people on any advisory team, including one spot reserved for a member of Council. Each staff person will also take on "Flagship Initiatives". These will be major projects that contribute to the objectives of the organization. They may also be ad-hoc projects as directed by Council or by circumstances that arise. As the first year of this new organization is completed, the involvement of the advisory teams will help further shape the organization, the key Flagship Initiatives and the Division's objectives.

**Focus & Priorities**

For the year 2003, the Division will focus its efforts on exploring the synergies created by combining the former Tourism Thunder Bay and Development Thunder Bay, as well as the one-stop shopping opportunities created by being part of the Development Department.

The Division's work in the coming year will involve four main priorities:

1. Set in place a comprehensive Customer Management Relations (CRM) program. This will include quality control, identifying what marketing our customers are responding to, tracking all of our efforts to at least attempt to measure their economic impacts, and feeding this back into further organization changes as necessary. This process will include exploring further opportunities that have arisen because of the combination of tourism and economic development as well as being part of the new Development Department. Part of the CRM program will also be to identify who each of our customers are (e.g.: citizens, Council, visitors, etc.) and how we can improve our communication efforts with them.
2. Develop a pro-active approach to growing our four main clusters. This will include a situational assessment of each cluster, a detailed action plan, and the establishment of cluster advisory teams. Developing initiatives that primarily support the retention and expansion of existing business but also help attract new businesses to the community. Developing relationships with our U.S. neighbours, particularly targeting the U.S. midwest.

### **Timmins/Cochrane/Temiskaming**

Several strategic plans for the city of Timmins can be obtained from:  
<http://www.city.timmins.on.ca/strategicplan-index.htm>

## Appendix 2 Top Employers in the Pan-Northern Region

### North Bay/Nipissing/Muskoka

Employer (for profit) # of Employees	Products/Services	Sector	
Ontario Northland Transportation Commission (ONTC)	916	Freight/passenger service	Business Service
Telespectrum Inc.	663	Call Centre	Business Service
Teletech Canada North Bay	500	Call Centre	Business Service
Columbia Forest Products	340	Forestry/Pulp	Manufacturing
Fabrene Inc	321	Woven Polyethalene	Manufacturing
ProNorth Transportation	280	Freight transportation	Business Service
Brinkman & Associates Reforestation Ltd.	251	Reforestation	Forestry
Wal-Mart Canada	234	Department Store	Wholesale/retail Trade
Donald F. Miller Food	200	Fast Food restaurants	Business Service
Tembec Forest Products Inc.	107	Forestry/Pulp	Manufacturing



<b>Employer (not for profit)</b>	<b># of Employees</b>	<b>Products/Services</b>	<b>Sector</b>
Near North School Board	2518	Elementary/Secondary Education	Education
Ministry of the Solicitor General and Correctional Services	1329	Correctional services	Other services
North Bay General Hospital	1141	General hospital	Health
Nipissing University	1061	Post Secondary Education	Education
Conseil Scolaire Catholique Franco-Nord	850	Elementary/Secondary Education	Education
Nipissing –Parry Sound Catholic District School Board	714	Elementary/Secondary Education	Education
North Bay Psychiatric Hospital	650	Psychiatric Services	Health
CFB North Bay	600	Canadian Forces	Other
City of North Bay	574	Municipal/Government	Other
Canadore College of Applied Arts and Technology	557	Post Secondary Education	Education

The top 25 job categories are listed below with the NAICS codes and location quotients for the Nipissing district.

Sectors (NAICS classification)	# employed in Ontario	Jobs in Nipissing District	Location Quotient (LQ) - Jobs in Nipissing District
722 Food services and drinking places	292,700	2,235	1.19
6111 Elementary and secondary schools	230,185	2,095	1.42
622 Hospitals	157,500	1,690	1.68
6220 Hospitals (6221 to 6223)	157,500	1,690	1.68
445 Food and beverage stores	145,300	1,275	1.37
541 Professional scientific and technical services	382,115	1,275	0.52
912 Provincial and territorial public administration	58,785	1,260	3.35
9120 Provincial and territorial public administration (9121 to 9129)	58,785	1,260	3.35
621 Ambulatory health care services	147,460	1,145	1.21
4451 Grocery stores	119,780	1,075	1.40
7221 Full-service restaurants	140,955	1,030	1.14
911 Federal government public administration	134,350	1,025	1.19
6230 Nursing and residential care facilities (6231 to 6239)	87,150	1,015	1.82
623 Nursing and residential care facilities	87,145	1,010	1.81
7222 Limited-service eating places	119,015	1,010	1.32
913 Local municipal and regional public administration	96,290	870	1.41
9130 Local municipal and regional public administration (9131 to 9139)	96,285	870	1.41
624 Social assistance	99,545	860	1.35
452 General merchandise stores	94,875	810	1.33
321 Wood product manufacturing	29,490	715	3.79
721 Accommodation services	52,355	645	1.92
9111 Defence services	27,470	615	3.50

**Sault Ste. Marie/Algoma**

<b>Employer (For Profit)</b>	<b># of employees</b>	<b>Products/Services</b>	<b>Sector</b>
Algoma Steel Inc.	3,000	Steel manufacturing	Manufacturing and construction industries
NuComm International	800	Call centre	Business services
Sunlite Floor Cleaner	680	Janitorial services and supplies	Business services
RMH Teleservices International	500	Call centre	Business services
St. Mary's Paper Ltd.	430	Pulp mill producing paper	Manufacturing and construction industries
EDS-GM Roadside Assistance	270	Call centre	Business services
Rome's Independent Grocer	220	Food (groceries) store	Wholesale and retail trade
Canadian Tire Store	170	Department store	Wholesale and retail trade
Algoma Central Railway	162	Mainline freight rail transportation	Business services

<b>Employer (not-for-profit)</b>	<b># of employees</b>	<b>Products/Services</b>	<b>Sector</b>
Ontario Lottery Corporation	7,952	Lottery, Gaming Operations	Other services
Sault Area Hospitals	1,712	General Hospitals	Health and education
Algoma District School Board	1,600	Elementary and Secondary Education	Health and education
City of Sault Ste. Marie	1,165	Municipal (local) Government Services	Other services
Huron-Superior Catholic District School Board	900	Elementary and Secondary Education	Health and education
Sault College of Applied Arts & Technology	500	Community Colleges and C.E.G.E.P's	Health and education
Community Living Algoma	425	Social Service Planning	Health and education
Group Health Centre	291	Public Health Clinics/Community	Health and education
Algoma Health Unit	170	Public Health Clinics/Community	Health and education
Algoma Treatment Remand Centre	160	Correctional Services	Other services

**Sudbury/Manitoulin/Parry Sound**

<b>Company</b>	<b>Sector</b>	<b># of Employees</b>	<b>Product/Service</b>
INCO Limited	Mining	4,425	Nickel - about 20% total global demand. Smelting applications, specialty nickel products, and plating products. Also produces copper, cobalt and precious metals.
Sudbury Regional Hospital	Health	2,800	Patient-focused health care
City of Greater Sudbury	Municipal Government	2,111	Government services
Sudbury Tax Services Office	Federal Government	1,961	Government services
Falconbridge Limited	Mining	1,488	Owns the following copper mines: Collahuasi, Collahuasi, Falconbridge Sudbury Div., Kidd Creek, Lomas Bayas, Montcalm, Raglan; copper smelters: Sudbury-Falconbridge, Timmins; copper refineries: Timmins. Produces copper as a by product of its nickel operations at Sudbury, Raglan and Kidds Creek
Rainbow District School Board	Education	1,375	Education services
Conseil scolaire de District catholique de Nouvel-Ontario	Education	823	Education services
Tele Tech	Call Centre	800	Outsourcing
Domtar	Manufacturing	790	Paper, pulp, wood, packaging
Your Independent Grocers	Retail	750	Grocery stores
Sudbury Catholic District School Board	Education	667	Education services
Laurentian University	Education	615	Education services

**Thunder Bay/Northwestern Ontario**

Major Employers in Various NWO Communities

<b>Thunder Bay</b>	<b>Kenora</b>
City of Thunder Bay	Lake of the Woods District Hospital
Municipal Government	Abitibi Consolidated
Thunder Bay Regional Health Sciences Centre	District of Kenora Home for the Aged
Lakehead District School Board	Trus Joist
Government of Ontario	Canadian Pacific Railway
Lakehead University	Kenora Patricia Child & Family Services
Bowater Canadian Forest Products	City of Kenora
Buchanan Group	Canada Safeway
Bombardier Transportation	Kenora Catholic District School Board
RMH International Teleservices	Zellers Inc.
Source: <a href="http://www.city-thunderbay.on.ca">www.city-thunderbay.on.ca</a>	Source : <a href="http://www.city.kenora.on.ca">www.city.kenora.on.ca</a>
<b>Dryden</b>	<b>Fort Frances</b>
Weyerhaeuser	Abitibi Consolidated Inc.
Keewatin Patricia Board of Education	Rainy River District School Board
City of Dryden	Canada Safeway
	Riverside Health Care

**Timmins/Cochrane/Temiskaming**

Size Categories: B = 101 to 200, C = 201 to 500, D = 501+

<b>Employer</b>	<b>Industry Sector</b>	<b>Size Category/ # of Employees</b>	<b>Locations Community</b>
Falconbridge Ltd. - Kidd Creek Metallurgical Division	Mining	D/ 865 <sup>1</sup>	Timmins
Timmins & District Hospital	Health Care & Social Services	D/ 834 <sup>2</sup>	Timmins
Teletech Inc.	Administrative and Support Services	D/ 808 <sup>2</sup>	Timmins
Porcupine Joint Venture	Mining	D/ 826 <sup>2</sup>	Timmins
Tembec Inc.	Manufacturing	D/ 1155+ <sup>1,3</sup>	Timmins, Kapuskasing, Cochrane/Iroquois Falls, Hearst, Chapleau
Northern College of Applied Arts & Tech.	Educational Services	D/ 750 <sup>1</sup>	South Porcupine
Grant Forest Products Inc.	Manufacturing	D/ 600 <sup>1</sup>	Kirkland lake, Timmins
Falconbridge - Kidd Creek Mine	Mining	C/ 566 <sup>2</sup>	Timmins
City of Timmins	Public Administration	C	Timmins
District School Board Ontario North East	Educational Services	C/ 300 <sup>2</sup>	Timmins
Conseil scolaire catholique de district des Grandes Rivieres	Educational Services	C/ 303 <sup>2</sup>	Timmins
Northeastern Catholic District School Board	Educational Services	C/ 335 <sup>2</sup>	Timmins
Northern Tel Ltd.	Utilities	C	Timmins
Kirkland and District Hospital	Health Care & Social Services	C	Kirkland Lake
Abitibi Consolidated, Iroquois Falls	Manufacturing	C/ 500 <sup>3</sup>	Cochrane/Iroquois Falls
Columbia Forest Products	Manufacturing	C	Hearst
Canadian National Railway, Hornepayne	Transportation	C	Hearst
Canadian Pacific Rail	Transportation	C	Chapleau
Wabi Iron & Steel Corp.	Manufacturing	C/ 245 <sup>1</sup>	New Liskeard
City of Timmins - Golden Manor	Health Care & Social Services	B/ 194 <sup>4</sup>	Timmins
J.S. Redpath Ltd.	Mining	B/ 350 <sup>2</sup>	Timmins
Domtar - McChesney Lumber Division	Manufacturing	B/ 132 <sup>3</sup>	Timmins
Dumas Mining Contracting Ltd.	Mining	B	Timmins
Millson Forestry Service	Forestry Service	B/ 145 <sup>4</sup>	Timmins
Child and Family Services - Cochrane District	Health Care & Social Services	B/ 189 <sup>4</sup>	Timmins

<sup>1</sup> Industry Canada<sup>2</sup> Northern Ontario Business web page<sup>3</sup> Company's web site<sup>4</sup> City of Timmins

## Appendix 3 The Universities located in Northern Ontario

### Ontario Wide

For Comparative purposes the total enrollment numbers across Ontario are provided below.

<b>Total University Enrolment in Ontario</b>						
	<b>1994</b>	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>
Arts/Science General	24,646	23,587	22,629	21,827	21,999	23,444
Education	15,001	15,065	15,630	16,680	16,972	17,109
Fine and Applied Arts	9,184	9,342	9,504	9,555	9,104	9,954
Humanities	24,317	23,220	21,931	21,377	21,150	22,234
Social Sciences	72,025	70,717	70,183	69,039	69,355	69,711
Agriculture/Biology Science	14,851	15,368	16,022	16,589	16,451	15,938
Engineering	17,974	17,829	17,815	18,264	19,147	20,558
Health Professions	12,291	12,257	11,883	11,637	11,211	11,864
Math and Physical Science	12,365	13,029	12,608	13,241	14,091	15,370
NR/NA	2,964	2,927	3,979	3,970	4,308	4,588
<b>Total</b>	<b>205,618</b>	<b>203,341</b>	<b>202,184</b>	<b>202,179</b>	<b>203,788</b>	<b>210,770</b>

Source: [www.cou.on.ca](http://www.cou.on.ca)

<b>Total University Graduates in Ontario</b>					
	<b>1994</b>	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>
Arts/Science General	1,260	1,314	1,553	1,359	1,460
Education	7,535	7,743	7,721	7,849	7,956
Fine and Applied Arts	1,790	1,794	1,904	1,815	1,820
Humanities	8,406	8,024	7,910	7,258	7,017
Social Sciences	22,582	22,857	22,556	21,749	21,548
Agriculture/Biology Science	3,446	3,630	3,816	4,030	4,174
Engineering	3,365	3,585	3,765	3,587	3,709
Health Professions	2,495	2,709	2,826	2,698	2,838

Math and Physical Science	3,034	3,123	3,118	3,096	3,142
<b>Total</b>	<b>53,913</b>	<b>54,779</b>	<b>55,169</b>	<b>53,441</b>	<b>53,664</b>
<b>Source: <a href="http://www.cou.on.ca">www.cou.on.ca</a></b>					



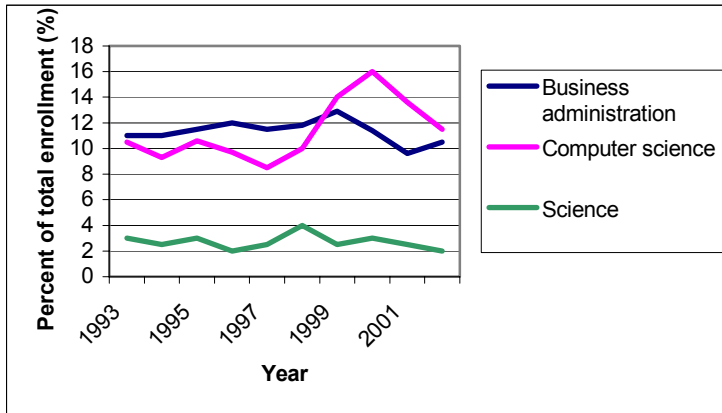
**Algoma University College**

**Total 2003 Algoma University College enrollment compared to all Ontario universities combined**

Year	Algoma University College	Ontario
2003	950	319,254

**Business administration and science enrolment at Algoma University College in 2003.**

Program	Enrollment
Business administration	160
Computer science	80
Science	30



*Percent of total student body enrolled in business administration, computer science, and science programs at Algoma University College between 1993 and 2002*

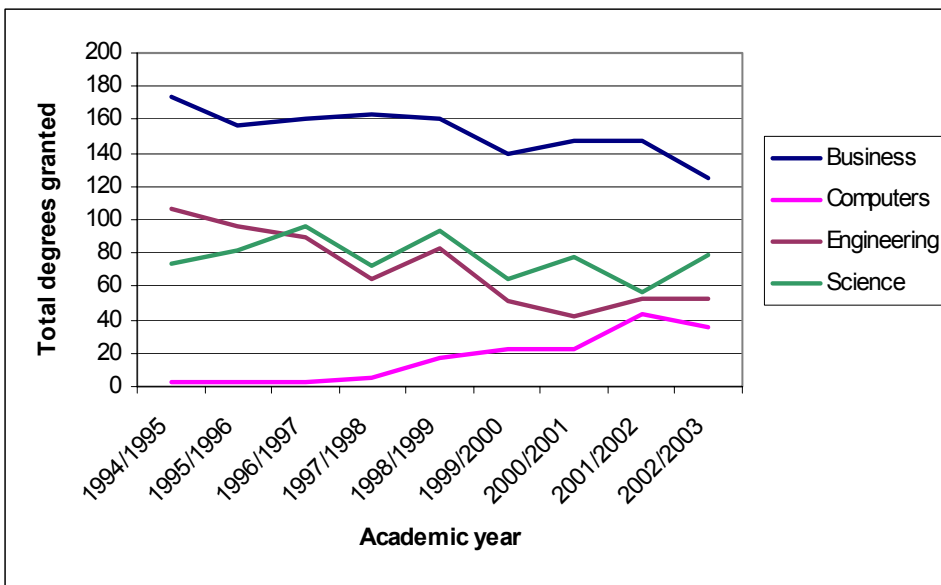
Note: currently, AUC does not grant graduate degrees; however, The University of Abertay (Dundee, Scotland) will be requesting Ministerial approval to offer their Master of Science in Computer Games Technology at the AUC campus.

**Lake Superior State University**

Degrees earned in business, computers, engineering, and science at Lake Superior State from 1994/1995 to 2002/2003

<b>Year</b>	<b>Business</b>	<b>Computers</b>	<b>Engineering</b>	<b>Science</b>	<b>Degree</b>
1994/1995	19	0	61	18	Less than 4 year degree
	110	2	45	56	Baccalaureate degree
	45	N/A	N/A	N/A	Masters degree
	174	2	106	74	Total degrees
1995/1996	18	0	52	23	Less than 4 year degree
	109	2	44	59	Baccalaureate degree
	29	N/A	N/A	N/A	Masters degree
	156	2	96	82	Total degrees
1996/1997	30	3	49	22	Less than 4 year degree
	115	0	40	74	Baccalaureate degree
	36	N/A	N/A	N/A	Masters degree
	161	3	89	96	Total degrees
1997/1998	27	1	14	11	Less than 4 year degree
	91	4	50	62	Baccalaureate degree
	45	N/A	N/A	N/A	Masters degree
	163	5	64	73	Total degrees
1998/1999	22	7	7	20	Less than 4 year degree
	120	10	76	74	Baccalaureate degree
	18	N/A	N/A	N/A	Masters degree
	160	17	83	94	Total degrees
1999/2000	17	11	10	11	Less than 4 year degree
	93	11	41	53	Baccalaureate degree

	30	N/A	N/A	N/A	Masters degree
	140	22	51	64	Total degrees
2000/2001	18	7	4	16	Less than 4 year degree
	111	16	38	61	Baccalaureate degree
	18	N/A	N/A	N/A	Masters degree
	147	23	42	77	Total degrees
2001/2002	14	28	11	15	Less than 4 year degree
	106	15	41	42	Baccalaureate degree
	27	N/A	N/A	N/A	Masters degree
	147	43	52	57	Total degrees
2002/2003	11	18	10	8	Less than 4 year degree
	92	18	43	71	Baccalaureate degree
	22	N/A	N/A	N/A	Masters degree
	125	36	53	79	Total degrees



**Total degrees granted in business, computers, engineering, and science at Lake Superior State University from 1994/1995 to 2002/2003**

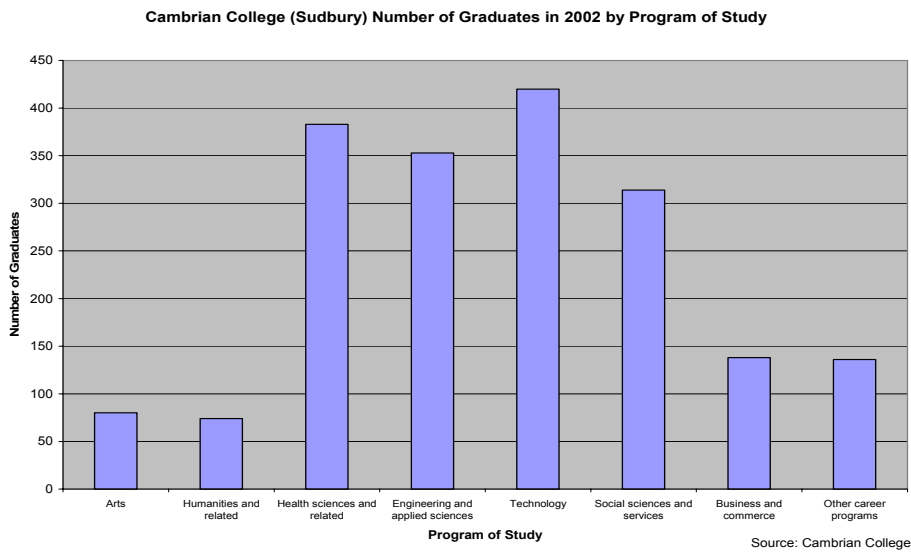
**Lakehead University**

<b>Undergraduate Enrolment</b>										
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Sciences										
Anthropology	58	80	96	104	93	70	56	45	32	46
Biology	180	215	205	212	200	188	164	147	141	127
Chemistry	39	45	52	47	31	31	22	32	15	17
Environmental Science	-	-	-	-	-	10	29	46	52	63
Forestry/Forest Environment	210	220	231	239	267	313	266	231	183	152
Geology	13	8	10	10	16	28	28	25	24	18
Mathematical Sciences	83	112	32	27	21	17	18	17	15	25
Natural Science	84	104	74	52	44	46	29	22	22	45
Physics	36	25	25	31	26	20	15	23	23	23
Engineering	599	571	499	489	457	458	504	495	479	531
Computer Sciences	-	-	87	97	114	125	98	113	87	66
Business										
Business Administration	435	422	425	435	436	449	385	373	338	342
Economics	45	38	28	12	17	17	19	20	15	25
Health Professions										
Kinesiology	307	314	317	356	373	321	313	286	230	236
Medical and Lab Studies	31	42	30	11	9	2	-	-	-	-
Nursing	213	205	182	166	141	124	118	127	197	268
Social Work	164	166	159	159	168	150	117	123	145	130
Programs of Study										
General Arts and Science	494	495	503	430	421	391	387	360	269	311
Education	868	887	865	934	1,00	1,05	1,18	1,248	1,37	1,428
Fine and Applied Arts	98	207	120	116	103	92	80	73	66	72
Humanities	416	427	380	304	207	194	170	184	227	239
Social Sciences	1,56	1,60	1,52	1,47	1,37	1,20	1,01	954	928	997
Biological Science	950	1,01	962	1,02	1,09	1,05	970	913	799	790
Engineering	809	791	730	728	724	771	770	726	662	683
Health Professions	244	247	212	177	150	126	118	127	197	268

Math and Physical Science	158	182	196	202	192	193	153	185	140	131
<b>Totals</b>	<b>5,60</b>	<b>5,84</b>	<b>5,49</b>	<b>5,38</b>	<b>5,26</b>	<b>5,08</b>	<b>4,84</b>	<b>4,770</b>	<b>4,66</b>	<b>4,919</b>
<b>Source: <a href="http://www.lakeheadu.ca">www.lakeheadu.ca</a></b>										

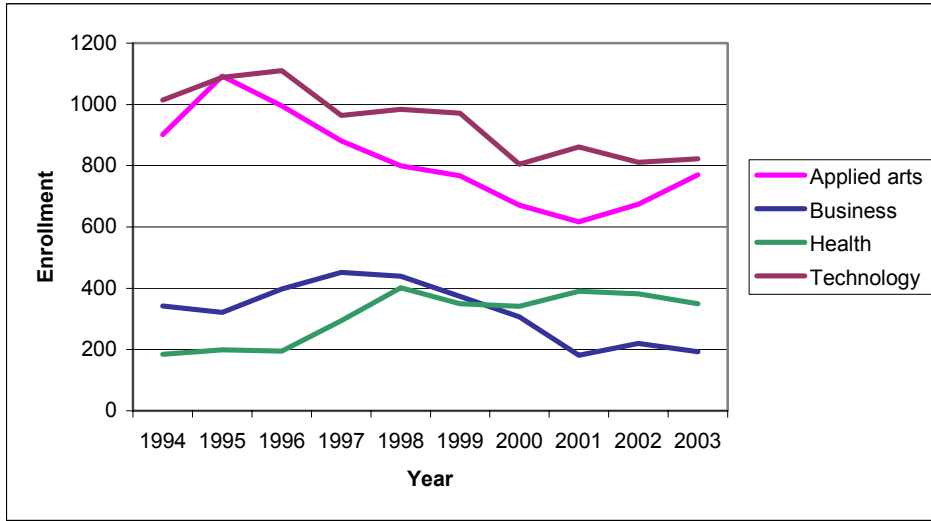
# Appendix 4 The Colleges of Northern Ontario

## Cambrian College



**Distribution of graduates from the programs of Cambrian College.**

**Sault College of Applied Arts and Technology**



**Enrollment in applied arts, business, health, and technology programs at Sault College from 1994 to 2003**

**Science, engineering, and business diplomas granted from Sault College between 1994 and 2003**

Year	Number of science, engineering, business diplomas granted
1994	553
1995	447
1996	506
1997	476
1998	518
1999	495
2000	561
2001	452
2002	396
2003	400



**Confederation College (Thunder Bay)**

<b>Confederation College Program Enrolment</b>													
	<b># of years</b>	<b>1992</b>	<b>1993</b>	<b>1994</b>	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>
<b>Business</b>													
Number of Programs (21)		421	526	537	530	596	631	569	491	484	448	356	320
<b>Hospitality</b>													
Number of Programs (3)		39	54	35	48	68	61	70	84	73	56	44	60
<b>Human Services</b>													
Number of Programs (10)		177	187	168	217	200	208	178	182	181	182	194	189
<b>Health Sciences</b>													
Dental Assistant	1	30	30	29	27	29	27	29	31	30	25	29	28
Dental Hygiene	2	15	14	16	-	-	-	-	-	-	-	-	-
Nursing Assistant	2	21	22	24	-	-	-	-	-	-	-	-	-
Practical Nursing	1	-	-	-	-	34	35	27	36	29	26	27	1
LU/CC Collaborative Nursing	1	-	-	-	-	-	-	-	-	-	-	-	-
Nursing Diploma	4	66	66	70	1	3	-	-	-	-	-	-	-
Radiography	3	7	8	8	8	8	-	-	-	-	-	-	-
Medical Radiation Technician	3	-	-	-	-	-	8	7	6	8	7	7	7
Paramedic	2	-	-	-	-	-	-	-	-	-	-	-	30
<b>General Arts and Sciences</b>													
General Arts and Science (1 yr.)	1	-	-	-	-	-	-	-	-	-	-	-	-
General Arts and Science (2 yr.)	2	163	161	156	172	222	169	211	202	222	181	187	56
<b>Media Arts</b>													
Number of Programs (3)		50	66	75	81	94	76	58	76	90	98	91	80
<b>Aviation and Engineering Technology</b>													
Aviation Programs (5)		79	96	82	64	64	60	73	82	84	61	80	69
Architectural Technology	3	12	9	7	12	7	12	9	4	12	8	10	9
Civil Engineering	3	9	19	16	19	17	9	17	12	8	13	24	12
Construction Engineering Technology	2	8	12	-	10	9	5	5	-	-	-	-	-
Environmental Engineering	3	-	-	-	21	28	33	25	22	29	31	26	13
Interior Design	3	7	5	6	-	-	-	-	-	-	-	-	-
Mechanical Engineering Technology	2	7	7	12	10	4	7	-	-	-	-	-	15
<b>Negahneewin College</b>													
Number of Programs (3)		44	80	57	54	37	62	51	64	53	77	52	54
<b>Totals</b>		<b>3,147</b>	<b>3,355</b>	<b>3,292</b>	<b>3,269</b>	<b>3,416</b>	<b>3,400</b>	<b>3,327</b>	<b>3,291</b>	<b>3,303</b>	<b>3,214</b>	<b>3,129</b>	<b>2,946</b>
<b>Graduate Numbers</b>		-	<b>969</b>	<b>1,012</b>	<b>1,033</b>	<b>1,019</b>	<b>1,118</b>	<b>978</b>	<b>995</b>	<b>1,007</b>	<b>995</b>	<b>1,074</b>	-

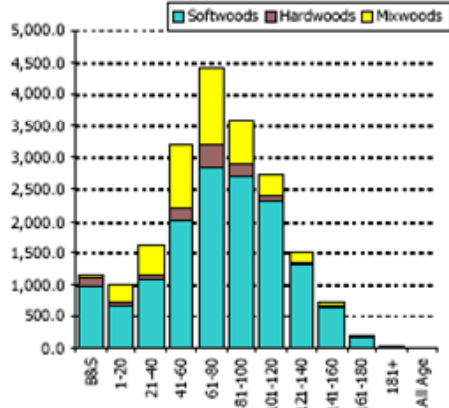
# Appendix 5 Harvest Rates and Sustainability of Forestry Resources in Northwestern Ontario

**Available Harvest Volumes by Species Groups and Terms in the Northwest Region**

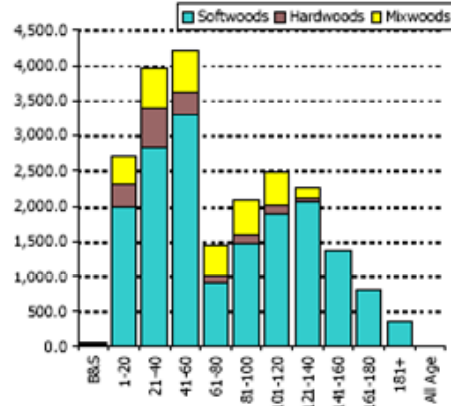
Year	Volume in Thousands of Cubic Metres						Total
	White and Red Pine	Spruce, Jack Pine, Fir	Other Conifers	Poplar	White Birch	Hardwood	
2001	103.5	8,936.8	49.1	3,830.1	935.3	22.9	13,877.7
2011	93.5	8,286.9	47.4	3,595.4	850.1	22.4	12,895.7
2021	84.7	7,831.7	44.9	3,353.6	784.4	23.2	12,122.5
2031	76.9	7,577.0	41.2	3,147.2	735.8	21.6	11,599.7
2041	73.7	7,400.4	37.5	2,892.5	675.5	19.5	11,099.1
2051	68.8	7,309.3	35.5	2,654.7	615.5	17.5	10,701.3
2061	63.5	7,281.4	34.4	2,485.9	571.5	16.1	10,452.8
2071	58.0	7,489.4	33.2	2,427.0	539.8	14.5	10,561.9
2081	52.9	7,989.9	30.4	2,548.3	487.2	13.1	11,121.8
2091	49.2	8,655.2	28.1	2,756.3	445.0	11.8	11,945.6
2101	47.4	9,491.0	27.2	2,940.4	410.9	11.1	12,928.0
2111	45.3	10,404.8	26.3	3,143.8	397.6	11.0	14,028.8
2121	44.2	11,379.4	26.1	3,419.4	401.9	11.3	15,282.3
<b>Average</b>	<b>66.3</b>	<b>8,464.1</b>	<b>35.5</b>	<b>3,015.0</b>	<b>603.9</b>	<b>16.6</b>	<b>12,201.3</b>

Source: State of the Forest Report 2001

Available Forest Area by Forest Unit Group - 2001



Available Forest Area by Forest Unit Group - 2051

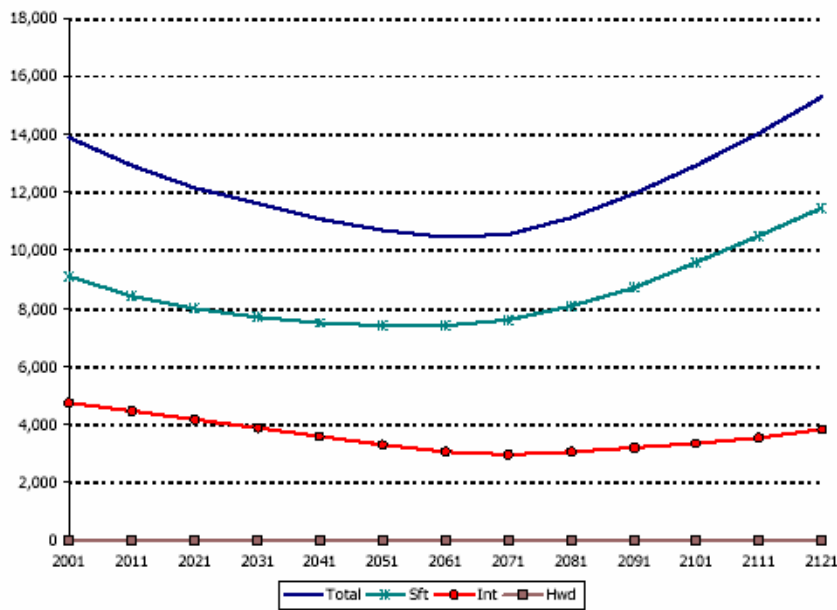


Current (2001) and projected (2051) harvest areas of the Northwestern forestry resources

Source: State of the Forest Report 2001

Available Harvest Volumes by Species Groups and Term

Volume in thousands of cubic metres



Current and projected available forestry harvest volumes for the years 2001 – 2121

Source: State of the Forest Report 2001

### Regional Biomass Resources

Data and statistics regarding the quantity of biomass resources were not available. General statistics regarding the type of land area in Northwestern Ontario has been shown below to show the significant amount of forest and non-forest area, which is home to several types of plants, trees, and other living species. As an emerging area, a substantial amount of research in this area is ongoing in Northwestern Ontario.

<b>Area of Land and Water Based on Satellite Data</b>					
	Crown	Park	Other	Total	Proportion
<i>Non-Forested</i>					
Water	5,296.4	985.1	76.4	6,357.9	70.5%
Wetland	2,145.2	65.9	8.8	2,219.9	24.6%
Tundra	-	-	-	-	0.0%
Rock	184.1	21.2	6.6	211.9	2.3%
Field	5.7	0.8	119.0	125.5	1.4%
Agriculture	-	-	-	-	0.0%
Unclassified	64.2	2.7	36.3	103.2	1.1%
	7,695.6	1,075.7	247.1	9,018.4	100.0%
<i>Non-productive</i>					
Swamp	-	-	-	-	0.0%
Tree Bog/Fen	4,202.7	244.6	41.1	4,488.4	100.0%
	4,202.7	244.6	41.1	4,488.4	100.0%
<i>Productive forest</i>					
Dense Deciduous	1,358.8	143.2	321.6	1,823.6	6.5%
Dense Coniferous	7,400.0	873.2	96.8	8,370.0	29.6%
Mixed Deciduous	2,044.3	265.0	153.8	2,463.1	8.7%
Mixed Coniferous	2,847.3	452.9	98.5	3,398.7	12.0%
Sparse Deciduous	759.9	76.7	84.0	920.6	3.3%
Sparse Coniferous	5,928.1	675.1	72.1	6,675.3	23.6%
Disturbed (Clear cut)	981.5	16.6	53.8	1,051.9	3.7%
Disturbed (Burn)	1,333.5	140.0	1.8	1,475.3	5.2%
Disturbed (Old)	1,830.0	215.8	23.9	2,069.7	7.3%
	24,483.4	2,858.5	906.3	28,248.2	100.0%
<b>Total area</b>	<b>36,381.7</b>	<b>4,178.8</b>	<b>1,194.5</b>	<b>41,755.0</b>	

Source: State of the Forest Report 2001

# Appendix 6: The NOBI Steering Committee

## STEERING COMMITTEE MEMBERS – THUNDER BAY

Derik Brandt  
Manager, Tourism & Ec. Dev.  
City of Thunder Bay  
P.O. Box 800  
111 Syndicate Avenue, S.  
Thunder Bay, ON P7C 5K4

Phone: 807-625-3960 (Direct)  
Toll Free: 800-668-9360  
Fax: 807-625-3960  
dbrandt@ThunderBay.ca  
www.ThunderBay.ca

Alternate  
Shane Olson  
Development Officer  
Manager, Tourism & Ec. Dev.  
City of Thunder Bay  
P.O. Box 800  
111 Syndicate Avenue, S.  
Thunder Bay, ON P7C 5K4

Toll Free: 800-668-9360  
Fax: 807-623-3962  
solson@ThunderBay.ca  
www.ThunderBay.ca

Lynn Peterson  
Northwestern Ontario Municipal  
Association  
161 East Brock Street  
Thunder Bay, ON P7E 4H1

Phone: 807-468-4598 or  
807-626-0155  
Fax: 807-626-8163  
lpeterson@city.thunder-bay.on.ca  
www.noma.on.ca

Robert Thayer  
President & CEO  
Genesis Genomics Inc.  
1294 Balmoral St., 3<sup>rd</sup> Floor  
Thunder Bay, ON P7B 5Z5

Phone: 807-768-4502  
Fax: 807-346-8105  
robert.thayer@genesishgenomics.com  
www.genesishgenomics.ca

## STEERING COMMITTEE MEMBERS – NORTH BAY

Rick Evans  
Manager, Economic Development  
City of North Bay  
P.O. Box 360  
200 McIntyre Street, E.  
North Bay, ON P1B 8H8

Phone: 800-465-1882, X431  
or 705-474-0626, X431  
Fax: 705-474-4493  
rick.evans@cityofnorthbay.ca  
www.city.north-bay.ca

Randy Moggach  
Coordinator, Biotechnology  
Program  
Canadore College  
P.O. Box 5001  
100 College Drive  
North Bay, ON P1B 8K9

Phone: 705-474-7601, X5167  
Fax: 705-474-2384  
[moggachr@canadorec.on.ca](mailto:moggachr@canadorec.on.ca)

**STEERING COMMITTEE MEMBERS – S. S. MARIE**

Errol Caldwell  
Program Director, Integrated Pest  
Management  
Canadian Forest Service  
1219 Queen Street, E.  
Sault Ste. Marie, ON P6A 2E5

Phone: 705-541-5558  
Fax: 705-541-5703  
ecaldwel@nrca.gc.ca

Bruce Strapp  
President & CEO  
SSM Economic Development Corp.  
99 Foster Drive, Level 3  
Sault Ste. Marie, ON P6A 5X6

Phone: 705-759-5432  
Fax: 705-759-2185  
b.strap@ssmedc.ca  
[www.sault-canada.com](http://www.sault-canada.com)

**STEERING COMMITTEE MEMBERS – SUDBURY**

Dr. Magdy Basta  
President and CEO  
Northern Centre for Biotechnology  
& Clinical Research (NEUREKA!)  
933 Ramsey Lake Road  
Sudbury, ON P3E 6B4

Phone: 705-671-2954  
Fax: 705-671-9478  
mbasta@neureka.com  
www.neureka.com

Executive Assistant  
Nicole Coulombe  
Phone: 705-671-2873, X107  
[ncoulombe@neureka.com](mailto:ncoulombe@neureka.com)

Stephanie Harris  
Business Development Officer  
Greater Sudbury Development  
Corporation  
P.O. Box 5000, Station A  
200 Brady Street  
Sudbury, ON P3A 5P3

Phone: 705-674-4455, X4606  
Fax: 705-671-6767  
stephanie.harris@city.greatersudbury.  
on.ca  
www.city.greatersudbury.on.ca

Lisa Providence  
Northern Centre for  
Biotechnology  
& Clinical Research  
933 Willet Green Miller Centre  
5<sup>th</sup> Floor  
Sudbury, ON P3E 6B4

Phone: 705-671-2873  
Fax: 705-671-9478  
lprovidence@neureka.com

(administrative support to NOBI)

**STEERING COMMITTEE MEMBERS – TIMMINS**

Mark Kean  
Mikro-Tek Inc.  
115 Sandy Falls Road  
P.O. Box 2120  
Timmins, ON P4N 7X8

Phone: 705-268-3536  
Fax: 705-268-7411  
mikro-tek@mikro-tek.com

Christy Marinig  
Manager  
Timmins Economic Development  
54 Spruce Street South  
Timmins, Ontario  
P4N 2M5

Tel: 705-360-8486  
Fax: 705-360-1394  
tedc@city.timmins.on.ca  
Website: [www.timminsedc.com](http://www.timminsedc.com)

**PROJECT MANAGEMENT**

Sharon Cuddy  
Project Coordinator  
ULERN (Upper Lakes Environmental  
Research Network)  
c/o Great Lakes Forestry Centre  
1219 Queen Street East, Sault Ste.  
Marie, ON P6A 2E5  
Phone 705-541-5718

Margo Shaw  
Director (as of Sept. 10, 2004)  
ULERN (Upper Lakes Environmental  
Research Network)  
c/o Great Lakes Forestry Centre  
1219 Queen Street East, Sault Ste.  
Marie, ON P6A 2E5  
Phone 705-541-5740

Peter Gagnon  
Acting Director  
ULERN (Upper Lakes  
Environmental  
Research Network)  
c/o Great Lakes Forestry Centre  
1219 Queen Street East, Sault  
Ste. Marie, ON P6A 2E5  
Phone 705-541-5740

Fax: 705-253-9986  
scuddy.ulern@nrcan.gc.ca  
www.ulern.on.ca

Fax: 705-253-9986  
mshaw.ulern@nrcan.gc.ca  
www.ulern.on.ca

Fax: 705-253-9986  
[Pgagnon.ulern@nrcan.gc.ca](mailto:Pgagnon.ulern@nrcan.gc.ca)  
www.ulern.on.ca

# Appendix 7: Detailed Financial Plan

	2004	2005	2006	2007	2008	Total Over 5 Years
<b>Expenses</b>						
<i>Salaries &amp; Benefits</i>						
Executive Director	\$ 25,000	\$ 100,000	\$ 103,000	\$ 106,090	\$ 109,273	\$ 443,363
Sector Representatives:						
Bioproducts	\$ -	\$ 80,000	\$ 82,400	\$ 84,872	\$ 87,418	\$ 334,690
Biomedical	\$ -	\$ 80,000	\$ 82,400	\$ 84,872	\$ 87,418	\$ 334,690
Environment	\$ -	\$ 80,000	\$ 82,400	\$ 84,872	\$ 87,418	\$ 334,690
Administrative Support	\$ -	\$ 25,000	\$ 25,750	\$ 50,000	\$ 51,500	\$ 152,250
Sub-Total	\$ 25,000	\$ 365,000	\$ 375,950	\$ 410,706	\$ 423,027	\$ 1,599,683
<i>Administration Costs</i>						
Space, equipment & supplies:						
Executive Director's office	\$ -	\$ 8,000	\$ 8,240	\$ 8,487	\$ 8,742	\$ 33,469
Bioproducts office	\$ -	\$ 11,000	\$ 11,330	\$ 11,670	\$ 12,020	\$ 46,020
Biomedical office	\$ -	\$ 8,000	\$ 8,240	\$ 8,487	\$ 8,742	\$ 33,469
Environment office	\$ -	\$ 10,000	\$ 10,300	\$ 10,609	\$ 10,927	\$ 41,836
Travel & professional development	\$ -	\$ 126,000	\$ 126,000	\$ 126,000	\$ 126,000	\$ 504,000
Hospitality	\$ -	\$ 10,000	\$ 10,000	\$ 20,000	\$ 20,000	\$ 60,000
Sub-Total	\$ -	\$ 173,000	\$ 174,110	\$ 185,253	\$ 186,431	\$ 718,794
<i>Board of Director Costs</i>						
Travel	\$ 22,000	\$ 88,000	\$ 80,000	\$ 72,000	\$ 64,000	\$ 326,000
Administrative expenses	\$ 2,500	\$ 5,000	\$ 5,150	\$ 5,305	\$ 5,464	\$ 23,418
Start-up costs	\$ 25,000	\$ -	\$ -	\$ -	\$ -	\$ 25,000
Sub-Total	\$ 49,500	\$ 93,000	\$ 85,150	\$ 77,305	\$ 69,464	\$ 374,418
Contingency allowance	\$ 3,725	\$ 31,550	\$ 31,761	\$ 33,663	\$ 33,946	\$ 134,645
<b>Total Expenses</b>	<b>\$ 78,225</b>	<b>\$ 662,550</b>	<b>\$ 666,971</b>	<b>\$ 706,927</b>	<b>\$ 712,868</b>	<b>\$ 2,827,540</b>
<b>Revenues</b>						
In-Kind Contributions:						
Sault Ste. Marie	\$ -	\$ 11,000	\$ 11,330	\$ 11,670	\$ 12,020	\$ 46,020
Thunder Bay	\$ -	\$ 8,000	\$ 8,240	\$ 8,487	\$ 8,742	\$ 33,469
Sudbury	\$ -	\$ 10,000	\$ 10,300	\$ 10,609	\$ 10,927	\$ 41,836
Other (not yet defined)	\$ 2,500	\$ 5,000	\$ 5,150	\$ 5,305	\$ 5,464	\$ 23,418
Sub-Total	\$ 2,500	\$ 34,000	\$ 35,020	\$ 36,071	\$ 37,153	\$ 144,743
Cash Contributions:						
Sault Ste. Marie	\$ -	\$ 50,000	\$ 51,500	\$ 53,045	\$ 54,636	\$ 209,181
Thunder Bay	\$ -	\$ 50,000	\$ 51,500	\$ 53,045	\$ 54,636	\$ 209,181
Sudbury	\$ -	\$ 50,000	\$ 51,500	\$ 53,045	\$ 54,636	\$ 209,181
FedNor	\$ -	\$ 166,667	\$ 166,667	\$ 166,667	\$ 166,667	\$ 666,667
NOHFC	\$ -	\$ 62,500	\$ 62,500	\$ 62,500	\$ 62,500	\$ 250,000
Sub-Total	\$ -	\$ 379,167	\$ 383,667	\$ 388,302	\$ 393,076	\$ 1,544,211
<b>Total Revenues (not including BCIP)</b>	<b>\$ 2,500</b>	<b>\$ 413,167</b>	<b>\$ 418,687</b>	<b>\$ 424,372</b>	<b>\$ 430,228</b>	<b>\$ 1,688,954</b>
<b>BCIP Ask</b>	<b>\$ 75,725</b>	<b>\$ 249,383</b>	<b>\$ 248,284</b>	<b>\$ 282,555</b>	<b>\$ 282,639</b>	<b>\$ 1,138,586</b>
<b>Matching Contributions</b>	<b>\$ 2,500</b>	<b>\$ 413,167</b>	<b>\$ 418,687</b>	<b>\$ 424,372</b>	<b>\$ 430,228</b>	<b>\$ 1,688,954</b>



**Appendix 8A: North  
Bay/Nipissing/Muskoka Regional  
Innovation Profile**

**Appendix 8B: Sault Ste.  
Marie/Algoma Regional Innovation  
Profile**

**Appendix 8C:**

**Sudbury/Manitoulin/Parry Sound**

**Regional Innovation Profile**

# **Appendix 8D: Thunder Bay/Northwestern Ontario Regional Innovation Profile**

**Appendix 8E:**  
**Timmins/Cochrane/Temiskaming**  
**Regional Innovation Profile**